2002 Lincoln LS
Workshop Manual

Alphabetical Index

A B C D E F
G H I J K L
M N O P R S
T U V W Y

Table of Contents

1: General Information

00: Service Information

2: Chassis

04: Suspension

05: Driveline

06: Brake System

11: Steering System

3: Powertrain

03: Engine

07: Automatic Transmission

08: Manual Transmission, Clutch and Transfer Case

09: Exhaust System

10: Fuel System

4: Electrical

12: Climate Control System

13: Instrumentation and Warning Systems

14: Battery and Charging System

15: Audio Systems

17: Lighting

18: Electrical Distribution

19: Electronic Feature Group

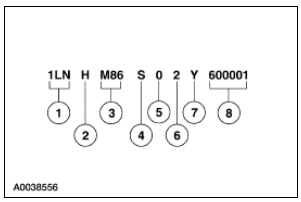
5: Body and Paint

01: Body

02: Frame and Mounting

Identification Codes

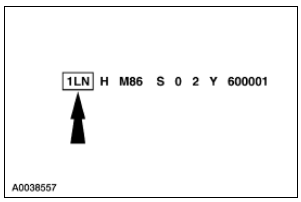
The vehicle identification number (VIN) is a 17-digit combination of letters and numbers. The VIN is stamped on a metal tab riveted to the instrument panel, top upper left of the dash. The VIN number is also found on the vehicle certification (VC) label.



Item	Description
1	World manufacturer identifier (WMI)
2	Restraint type code
3	Line and series
4	Engine code
5	VIN check digit
6	Model year code
7	Assembly plant code
8	Production sequence number

Vehicle Identification Number (VIN)

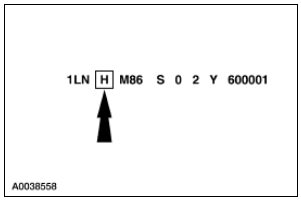
World Manufacturer Identifier



The first three vehicle identification number (VIN) positions are the world manufacturer code.

- 1LN Ford Motor Company Lincoln, USA, passenger car
- 1LJ Ford Motor Company Lincoln, USA, incomplete vehicle

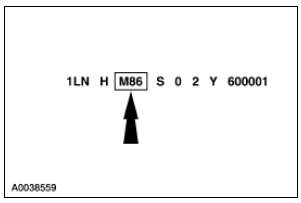
Vehicle Restraint Type



The fourth VIN position is the vehicle restraint system type code.

- H Active safety belts all positions, driver and front passenger air bags, driver and front passenger side impact air bags

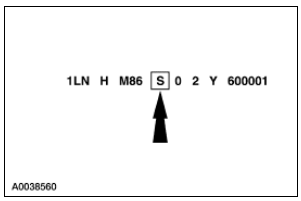
Line and Series



Positions 5 through 7 indicate vehicle line and series.

- M86 Lincoln LS six cylinder
- M87 Lincoln LS eight cylinder

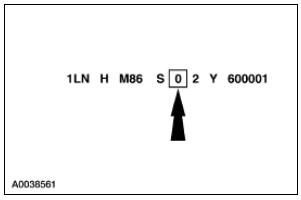
Engine Code



The eighth VIN position is the engine displacement and number of cylinders code.

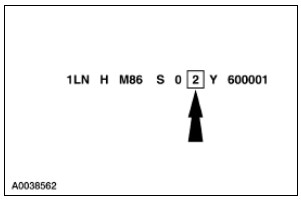
- A 3.9L, eight cylinder, DOHC, EFI
- S 3.0L, six cylinder, DOHC, EFI

Check Digit



The ninth VIN position is a computer generated check digit code (0-9).

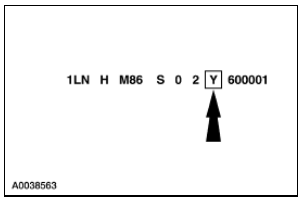
Model Year



The tenth VIN position is the model year code.

- 2 2002

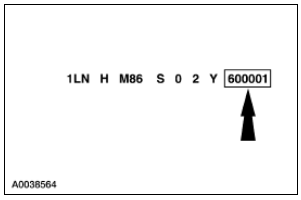
Assembly Plant



The eleventh VIN position is the assembly plant code.

- S Pilot Plant, Allen Park, Michigan (USA)
- Y Wixom, Michigan (USA)

Production Sequence Number

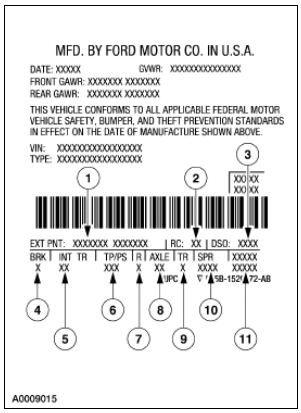


The last six VIN positions are the production sequence number. This set of numbers is also used as the vehicle serial and warranty number.

- Lincoln/Mercury Begins with 600001

Vehicle Certification (VC) Label

The upper portion of the vehicle certification (VC) label contains the manufacturer name, the month and year of manufacture, the certification statement and the VIN. It also includes gross vehicle weight ratings (GVWR). The VC label is located on the left-hand front door jamb.

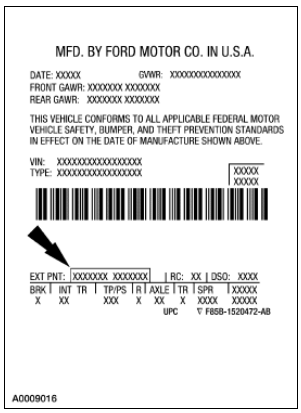


Item	Description
1	Exterior paint color code
2	Region code
3	Special order code (DSO domestic special order FSO foreign special order PTO paint, tire option special order)

4	Brake type code
5	Interior trim code
6	Tape/paint stripe code
7	Radio type code
8	Axle ratio code
9	Transmission code
10	Spring code
11	Powertrain calibration code

Vehicle Certification (VC) Label Reference

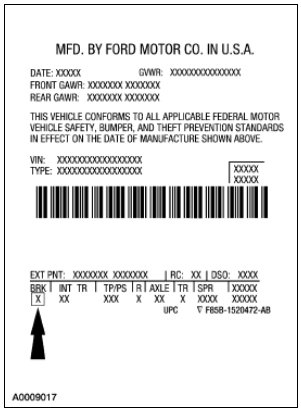
Paint Codes



The exterior color codes are:

- BQ Light Parchment Gold
- HC Ivory Parchment (tri-coat)
- GT Autumn Red Metallic
- TS Silver Frost Metallic
- TV Midnight Gray Metallic
- L2 True Blue Metallic
- L3 Pacific Blue Metallic
- F3 Medium Cypress Green Metallic
- W5 Ceramic White Solid
- UA Ebony Solid
- WF White Pearl (tri-coat)
- JP Silver Birch Metallic
- TC Charcoal Gray Metallic
- PS Aspen Green Metallic

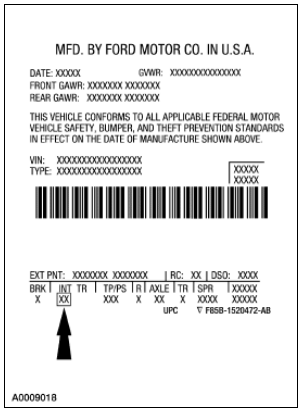
Brake Code



The brake type codes are:

- 6 Anti-lock brakes (ABS) with Advancetrac®
- 3 Anti-lock brakes (ABS) with Traction Control

Interior Trim Code



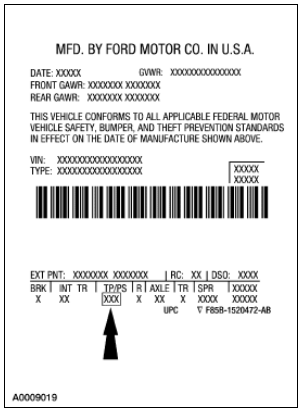
The interior trim codes are listed below. The first letter/number is for the interior fabric. The second letter/number is for the interior color.

- 4 Leather interior
- 5 Nudo leather (basket weave)

The interior trim colors are:

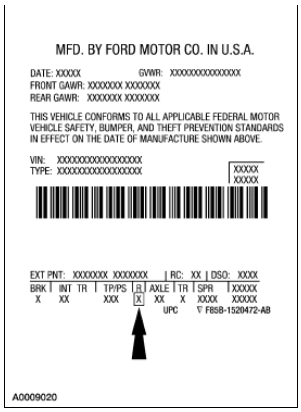
- H Medium Parchment
- T Truffle
- 2 Light Graphite
- G Light Parchment
- W Midnight Black

Tape/Paint Stripe Code



Tape and paint stripe codes do not apply.

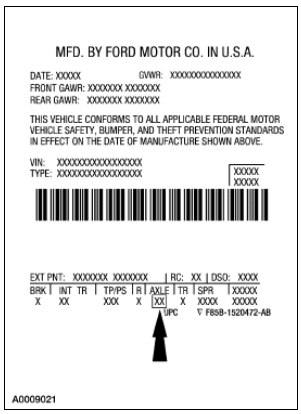
Radio Code



The radio type codes are:

- 8 Premium AM/FM stereo cassette with clock
- X AM/FM stereo with in-dash six disc CD changer
- S AM/FM stereo with cassette, clock and navigation system

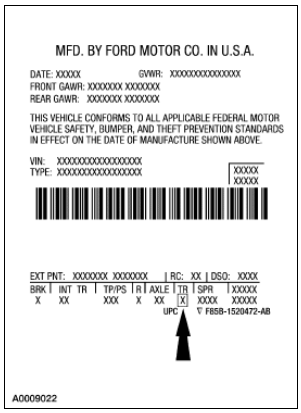
Axle Ratio Code



The axle ratios are:

- 1 3.58 conventional (3.0L and 3.9L engines)
- 2 3.31 conventional (3.9L engine)
- 3 3.07 conventional (3.0L engine with manual transmission)

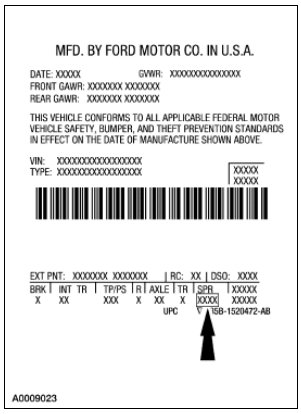
Transmission Code



The transmission/transaxle codes are:

- 5 5-Speed manual (M5 221), Getrag
- A 5-speed, automatic (5R55N), Sharonville

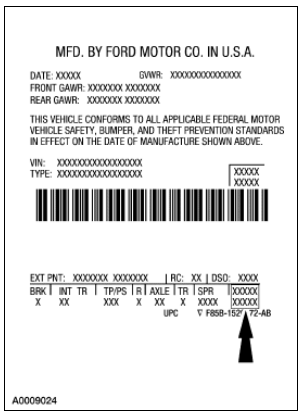
Spring Code



The spring codes are:

- Front spring modules base part number 5310
- Rear spring base part number 5560

Powertrain Calibration Information

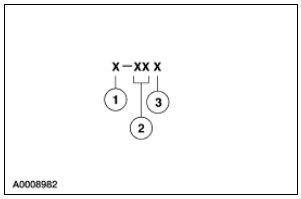


NOTE: Powertrain calibration information is limited to a maximum of five characters per line on the Vehicle Certification (VC) Label. Because of this, calibration identification consisting of more than five characters

will wrap to the second line in the powertrain calibration field of the VC label.

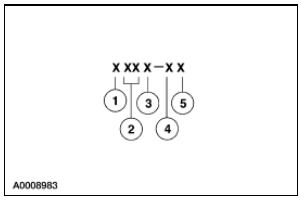
Powertrain calibration information is printed in the lower right corner of the Vehicle Certification (VC) Label. Only the base calibration information is printed. Revision levels will not appear, however, they can be found in On Line Automotive Service Information System (OASIS). For the current model year, Ford Motor Company is using three different protocols which describe powertrain base calibration. These protocols are designed to provide worldwide standardization for vehicle calibration. If the electronic calibration strategy has been used since 1998 and carried into the current model year, Protocol 1 will be used. Refer to Protocol 1 below. If the electronic calibration strategy was introduced in 1999 and carried into the current model year, Protocol 2 will be used. Refer to Protocol 2 below. For electronic calibration introduced in 2000 through the current model year, Protocol 3 is used. Refer to Protocol 3 below.

Protocol 1



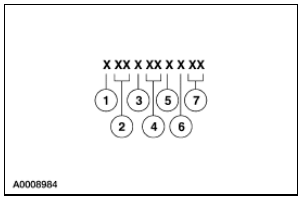
Item	Description
1	Model year (year in which calibration strategy was introduced)
2	Engine code
3	Engine revision level

Protocol 2



Item	Description
1	Model year (year in which calibration strategy was introduced)
2	Engine code
3	Transmission code
4	Emission standard (designates the specific country emission standard)
5	Design level (design level assigned to the engine)

Protocol 3



Item	Description
1	Model year
2	Vehicle code
3	Transmission code
4	Unique calibration
5	Fleet code
6	Certification region
7	Revision level (will advance as revisions occur). Not printed on label

Protocol 3

The following offers a more detailed explanation of the coding strategy for Protocol 3.

Model Year
- 1 2001
- 2 2002

Vehicle Line
- LQ Lincoln LS

Transmission
- 1 Automatic transmission
- 2 Manual transmission

Unique Calibration

The Emission/CAFE/CO2 Compliance Department is responsible for assigning these calibration numbers. Unique calibration identifications are assigned to cover similar vehicle to differentiate tires, drive configurations, final drive ratios and other certification-significant factors.

These two characters are chosen by the analyst to provide easily identifiable information unique to each calibration. For example, using the number 2 to denote a two-valve engine versus the number 4 to denote a four-valve engine.

Fleet Code
- 0 Certification (U. S. 4K, final sale in an export market)
- 1 HDGE/Dyno
- 2 Fast AMA U. S.
- 3 ADP U. S.
- 4 Not assigned
- 5 Not assigned
- 6 Evaporative emissions
- 7 MACAA
- 8 On-board diagnostics

- 9 Not assigned

Certification Region

- 5 U. S. fifty states
- A U. S. federal, including altitude, may include Canada and Mexico
- B U. S. California standard, includes U. S. green states
- C Canada
- D China
- E European community
- F Israel, South Korea
- G Gulf Cooperative Council (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, Jordan, Lebanon and UAE)
- J Japan
- K Korea
- L Malaysia
- M Mexico
- N New Zealand
- P Australia
- Q South America (Brazil)
- U South America (unleaded fuel regions)
- V Vietnam
- X Rest of world (ROW)
- Y Military
- Z Israel

Revision Level (not printed on label)

- 91-99 Hardware and certification levels
- 01-04 Preliminary levels
- 00 Job 1 production (initial certification)
- 05-09 Pre-job 1 revisions to calibrations
- 10-89 Post-job 1 revisions to calibrations
- 0B Durability test level
- BD On-board diagnostics (OBD) intermediate level (pre-05)

Jacking

⚠ WARNING: Never run the engine with one wheel off the ground, such as when changing a tire. The wheel still on the ground could cause the vehicle to move.

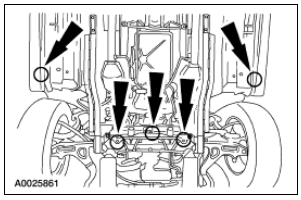
⚠ CAUTION: The jack (17080) provided with the vehicle is intended to be used in an emergency for changing a deflated tire. To avoid damage to the vehicle, never use the jack to lift the vehicle for any other purpose. Refer to the Owner Literature when using the jack supplied with the vehicle.

⚠ CAUTION: Under no circumstances should the vehicle ever be lifted by the front control arms, front I-braces, suspension arm brackets, rear stabilizer or differential housing. Severe damage to the vehicle could result.

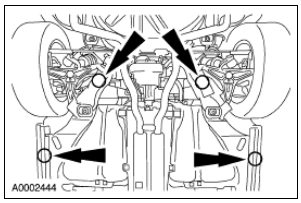
⚠ CAUTION: Do not attempt to use jack pressure on either the front bumper (17757) or the rear bumper (17906) of any vehicle. Damage to the bumper covers will occur.

Lift the vehicle using the following procedure.

Jacking Points



To lift the front or either side of the front end, position the floor jack or the hoist under the front frame lift points.



To lift the rear or either side of the rear end, position the floor jack or the hoist under the rear lift points.

Lifting

⚠ CAUTION: Do not allow the lift adapters to contact the steering linkage, suspension arms, front I-braces, stabilizer bar, or to compress the lower suspension arm stabilizer bar insulator (5493). Damage to the suspension, exhaust and steering linkage components may occur if care is not exercised when positioning the lift adapters prior to lifting the vehicle.

⚠ CAUTION: Never use the differential housing as a lift point. Damage to the differential housing and cover may occur.

⚠ CAUTION: Do not lift the vehicle on the rocker panel pinch flange except at the designated lift points or body damage may occur.

Lift the vehicle using the following procedure.

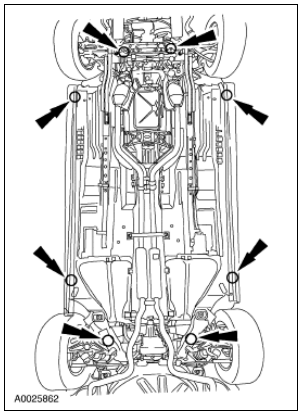
Lifting Points Drive-On Hoist

⚠ CAUTION: To prevent possible damage to the underbody, do not drive the vehicle onto the drive-on hoist without first checking for possible interference.

Check for interference between the upright flanges of the hoist rails and the underbody.

If an interference exists, modify the hoist flanges or build up the approach ramps as necessary to provide clearance.

Lifting Points Frame Contact Lift, Single-Post Lift, Two-Post Lift



⚠ CAUTION: Under no circumstances should the vehicle be lifted by the front control arms, front I-braces or rear control arms. Severe damage to the vehicle could result.

⚠ CAUTION: Do not position the lift pads under the No. 3 crossmember.

NOTE: Adapters maybe necessary to clear vehicle components to lift the vehicle safely. The adapters must be placed at the four designated contact points. Position the adapters so they are centered on the adapter contact area.

Lift the vehicle at the applicable lift points.

Noise, Vibration And Harshness (NVH)

Noise is any undesirable sound, usually unpleasant in nature. Vibration is any motion, shaking or trembling, that can be felt or seen when an object moves back and forth or up and down. Harshness is a ride quality issue where the vehicle's response to the road transmits sharply to the customer. Harshness normally describes a firmer than usual response from the suspension system. Noise, vibration and harshness (NVH) is a term used to describe these conditions, which result in varying degrees of dissatisfaction. Although, a certain level of NVH caused by road and environmental conditions is normal. This section is designed to aid in the diagnosis, testing and repair of NVH concerns.

Acceptable Noise, Vibration and Harshness

All internal combustion engines and drivelines produce some noise and vibration; operating in a real world environment adds noise that is not subject to control. Vibration isolators, mufflers and dampers reduce these to acceptable levels. A driver who is unfamiliar with a vehicle can think that some sounds are abnormal when actually the sounds are normal for the vehicle type. For example, Traction-Lok® differentials produce a slight noise on slow turns after extended highway driving. This is acceptable and has no detrimental effect on the locking axle function. As a technician, it is very important to be familiar with vehicle features and know how they relate to NVH concerns and their diagnosis. For example, if the vehicle has automatic overdrive, it is important to test drive the vehicle both in and out of overdrive mode.

Diagnostic Theory

The shortest route to an accurate diagnosis results from:

- system knowledge, including comparison with a known good system.
- system history, including repair history and usage patterns.
- condition history, especially any relationship to repairs or sudden change.
- knowledge of possible sources.
- using a systematic diagnostic method that divides the system into related areas.

The diagnosis and correction of noise, vibration and harshness concerns requires:

- a road or system test to determine the exact nature of the concern.
- an analysis of the possible causes.
- testing to verify the cause.
- repairing any concerns found.
- a road test or system test to make sure the concern has been corrected or brought back to within an acceptable range.

Glossary of Terms

Acceleration-Light

An increase in speed at less than half throttle.

Acceleration-Medium

An increase in speed at half to nearly full throttle, such as 0-97 km/h (0-60 mph) in approximately 30 seconds.

Acceleration-Heavy

An increase in speed at one-half to full throttle, such as 0-97 km/h (0-60 mph) in approximately 20 seconds.

Ambient Temperature

The surrounding or prevailing temperature.

Amplitude

The quantity or amount of energy produced by a vibrating component (G force). An extreme vibration has a high amplitude. A mild vibration has a low amplitude.

Backlash

Gear teeth clearance.

Boom

Low frequency or low pitched noise often accompanied by a vibration. Also refer to Drumming.

Bound Up

An overstressed isolation (rubber) mount that transmits vibration/noise instead of absorbing it.

Brakes Applied

When the service brakes are applied with enough force to hold the vehicle against movement with the transmission in gear.

Buffet/Buffeting

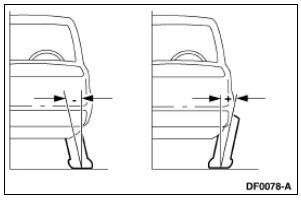
Strong noise fluctuations (less than 1000 Hz) caused by gusting winds. An example would be wind gusts against the side glass.

Buzz

A low-pitched sound like (200-5000 Hz) that from a bee. Often a metallic or hard plastic humming sound. Also describes a high frequency (200-800 Hz) vibration. Vibration feels similar to an electric razor.

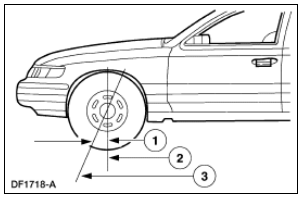
Camber

The angle of the wheel in relation to the true vertical as measured looking from the front of the vehicle. Camber is positive when the wheel angle is offset so that the top of the wheel is positioned away from the vehicle.



Caster

The angle of the steering knuckle in relation to the true vertical as measured looking from the side of the vehicle.



Item	Description
1	Positive caster
2	True vertical
3	Steering axis

Chatter

A pronounced series of rapidly repeating rattling or clicking sounds.

Chirp

A short-duration high-pitched noise associated with a slipping drive belt.

Chuckle

A repetitious low-pitched sound. A loud chuckle is usually described as a knock.

Click

A sharp, brief, non-resonant sound, similar to actuating a ball point pen.

Clonk

A hydraulic knocking sound. Sound occurs with air pockets in a hydraulic system. Also described as hammering.

Clunk/Driveline Clunk

A heavy or dull, short-duration, low-frequency sound. Occurs mostly on a vehicle that is accelerating or decelerating abruptly. Also described as a thunk.

Coast/Deceleration

Releasing the accelerator pedal at cruise, allowing the engine to reduce vehicle speed without applying the brakes.

Coast/Neutral Coast

Placing the transmission range selector in NEUTRAL (N) or depressing the clutch pedal while at cruise.

Constant Velocity (CV) Joint

A joint used to absorb vibrations caused by driving power being transmitted at an angle.

Controlled Rear Suspension Height

The height at which a designated vehicle element must be when driveline angle measurements are made.

Coupling Shaft

The shaft between the transfer case and the front drive axle or, in a two-piece rear driveshaft, the front section.

CPS

Cycles per second. Same as hertz (Hz).

Cracks

A mid-frequency sound, related to squeak. Sound varies with temperature conditions.

Creak

A metallic squeak.

Cruise

Constant speed on level ground; neither accelerating nor decelerating.

Cycle

The process of a vibrating component going through a complete range of motion and returning to the starting point.

Decibel

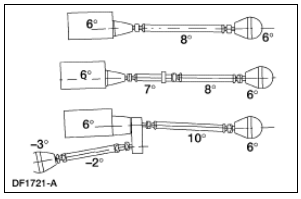
A unit of measurement, referring to sound pressure level, abbreviated dB.

Drive Engine Run-Up (DERU) Test

The operation of the engine through the normal rpm range with the vehicle standing still, the brakes applied and the transmission engaged. This test is used for noise and vibration checks.

Driveline Angles

The differences of alignment between the transmission output shaft, the driveshaft, and the rear axle pinion centerline.



Driveshaft

The shaft that transmits power to the rear axle input shaft (pinion shaft). In a two-piece driveshaft, it is the rearmost shaft.

Drivetrain

All power transmitting components from the engine to the wheels; includes the clutch or torque converter, the transmission, the transfer case, the driveshaft, and the front or rear drive axle.

Drivetrain Damper

A weight attached to the engine, the transmission, the transfer case, or the axle. It is tuned by weight and placement to absorb vibration.

Drone

A low frequency (100-200 Hz) steady sound, like a freezer compressor. Also described as a moan.

Drumming

A cycling, low-frequency (20-100 Hz), rhythmic noise often accompanied by a sensation of pressure on the ear drums. Also described as a low rumble, boom, or rolling thunder.

Dynamic Balance

The equal distribution of weight on each side of the centerline, so that when the wheel and tire assembly spins, there is no tendency for the assembly to move from side-to-side (wobble). Dynamically unbalanced wheel and tire assemblies can cause wheel shimmy.

Engine Imbalance

A condition in which an engine's center mass is not concentric to the rotation center, causing excessive motion.

Engine Misfire

When combustion in one or more cylinders does not occur or occurs at the wrong time.

Engine Shake

An exaggerated engine movement or vibration that directly increases in frequency as the engine speed increases. It is caused by non-equal distribution of mass in the rotating or reciprocating components.

Flexible Coupling

A flexible joint.

Float

A drive mode on the dividing line between cruise and coast where the throttle setting matches the engine speed with the road speed.

Flutter

Mid to high (100-2000 Hz) intermittent sound due to air flow. Similar to a flag flapping in the wind.

Frequency

The rate at which a cycle occurs within a given time.

Gravelly Feel

A grinding or growl in a component, similar to the feel experienced when driving on gravel.

Grind

An abrasive sound, similar to using a grinding wheel, or rubbing sand paper against wood.

Hiss

Steady high frequency (200-800 Hz) noise. Vacuum leak sound.

Hoot

A steady low frequency tone (50-500 Hz), sounds like blowing over a long neck bottle.

Howl

A mid-range frequency (200-800 Hz) noise between drumming and whine. Also described as a hum.

Hum

Mid-frequency (200-800 Hz) steady sound, like a small fan motor. Also described as a howl.

Hz

Hertz; a frequency measured in cycles per second.

Imbalance

Out of balance; heavier on one side than the other. In a rotating component, imbalance often causes vibration.

Inboard

Toward the centerline of the vehicle.

Intensity

The physical quality of sound that relates to the strength of the vibration (measured in decibels). The higher the sound's amplitude, the higher the intensity and vice versa.

Isolate

To separate the influence of one component to another.

Knock

A heavy, loud, repetitious sound, like a knock on the door.

Moan

A constant, low-frequency (100-200 Hz) tone. Also described as a hum.

Neutral Engine Run-Up (NERU) Test

The operation of the engine through the normal rpm range with the vehicle standing still and the transmission disengaged. This test is used to identify engine related vibrations.

Neutralize/Normalize

To return to an unstressed position. Used to describe mounts. Refer to Bound Up.

Outboard

Away from the centerline of the vehicle.

Ping

A short duration, high-frequency sound, which has a slight echo.

Pinion Shaft

The input shaft in a driving axle that is usually a part of the smaller driving or input hypoid gear of a ring and pinion gearset.

Pitch

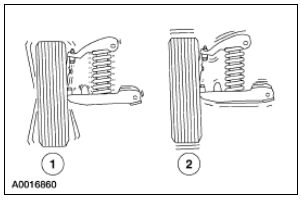
The physical quality of sound that relates to its frequency. Pitch increases as frequency increases and vice versa.

Pumping Feel

A slow, pulsing movement.

Radial/Lateral

Radial is in the plane of rotation; lateral is at 90 degrees to the plane of rotation.



Item	Description
1	Lateral runout
2	Radial runout

Rattle

A random and momentary or short duration noise.

Ring Gear

The large, circular, driven gear in a ring and pinion gearset.

Road Test

The operation of the vehicle under conditions intended to produce the concern under investigation.

Roughness

A medium-frequency vibration. A slightly higher frequency (20 to 50 Hz) than a shake. This type of vibration is usually related to drivetrain components.

Runout

Lateral runout means measuring the movement or "wobble" of a wheel or tire at the sidewall. Radial runout means measuring the out-of-round at the tread surface.

Rustling

Intermittent sound of varying frequency (100-2000 Hz), sounds similar to shuffling through leaves.

Shake

A low-frequency vibration (5-20 Hz), usually with visible component movement. Usually relates to tires, wheels, brake drums or brake discs if it is vehicle speed sensitive, or engine if it is engine speed sensitive. Also referred to as a shimmy or wobble.

Shimmy

An abnormal vibration or wobbling, felt as a side-to-side motion of the steering wheel in the driveshaft rotation. Also described as waddle.

Shudder

A low-frequency vibration that is felt through the steering wheel or seat during light brake application.

Slap

A resonance from flat surfaces, such as safety belt webbing or door trim panels.

Slip Yoke/Slip Spline

The driveshaft coupling that allows length changes to occur while the suspension articulates and while the driveshaft rotates.

Squeak

A high-pitched transient sound, similar to rubbing fingers against a clean window.

Squeal

A long-duration, high-pitched noise.

Static Balance

The equal distribution of weight around the wheel. Statically unbalanced wheel and tire assemblies can cause a bouncing action called wheel tramp. This condition will eventually cause uneven tire wear.

Tap

A light, rhythmic, or intermittent hammering sound, similar to tapping a pencil on a table edge.

Thump

A dull beat caused by two items striking together.

Tick

A rhythmic tap, similar to a clock noise.

Tip-In Moan

A light moaning noise heard during light vehicle acceleration, usually between 40-100 km/h (25-65 mph).

TIR

The acronym for total indicated runout is TIR.

Tire Deflection

The change in tire diameter in the area where the tire contacts the ground.

Tire Flat Spots

A condition commonly caused by letting the vehicle stand while the tires cool off. This condition can be corrected by driving the vehicle until the tires are warm. Also, irregular tire wear patterns in the tire tread resulting from wheel-locked skids.

Tire Force Vibration

A tire vibration caused by variations in the construction of the tire that is noticeable when the tire rotates against the pavement. This condition can be present on perfectly round tires because of variations in the inner tire construction. This condition can occur at wheel rotation frequency or twice rotation frequency.

Transient

A noise or vibration that is momentary, a short duration.

Two-Plane Balance

Radial and lateral balance.

Vibration

Any motion, shaking or trembling, that can be felt or seen when an object moves back and forth or up and down.

Whine

A constant, high-pitched noise. Also described as a screech.

Whistle

High-pitched noise (above 500 Hz) with a very narrow frequency band. Examples of whistle noises are a turbocharger or airflow around an antenna.

Wind Noise

Any noise caused by air movement in, out or around the vehicle.

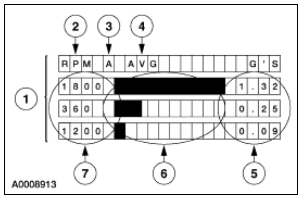
WOT

The acronym for wide open throttle is WOT.

Tools and Techniques

Electronic Vibration Analyzer (EVA)

The EVA is a hand-held electronic diagnostic tool which will assist in locating the source of unacceptable vibrations. The vibration sensor can be remotely mounted anywhere in the vehicle for testing purposes. The unit displays the three most common vibration frequencies and their corresponding amplitudes simultaneously. A bar graph provides a visual reference of the relative signal strength (amplitude) of each vibration being displayed and its relative G force. The keypad is arranged to make the EVA simple to program and use. Some of the functions include the ability to average readings as well as record, play back and freeze readings. The EVA has a strobe balancing function that can be used to detect imbalance on rotating components such as a driveshaft or engine accessories.



Item	Description
1	EVA screen
2	Frequency mode displayed in rpm or Hz
3	Active sensor input (A or B)
4	Current active mode
5	G force indicators or the strongest frequencies in descending strength of each vibration
6	Strength of each vibration
7	Frequency in rpm/Hz of each vibration

The EVA allows for a systematic collection of information that is necessary to accurately diagnose and repair NVH problems. For the best results, carry out the test as follows:

a. Test drive the vehicle with the vibration sensor inside the vehicle.
b. Place the sensor in the vehicle according to feel.

- If the condition is felt through the steering wheel, the source is most likely in the front of the vehicle.
- A vibration that is felt in the seat or floor only will most likely be found in the driveline, drive axle or rear wheels and tires.

c. Record the readings. Also note when the condition begins, when it reaches maximum intensity, and if it tends to diminish above/below a certain speed.
   - Frequencies should be read in the "average" mode.
   - Frequencies have a range of plus or minus 2. A reading of 10 Hz can be displayed as an 8 Hz through 12 Hz.

d. Place the vibration sensor on or near the suspect area outside the vehicle.
e. Continue the road test, driving the vehicle at the speed the symptom occurs, and take another reading.
f. Compare the readings.
   - A match in frequency indicates the problem component or area.
   - An unmatched test could indicate the concern is caused by the engine, torque converter, or engine accessory. Use the EVA in the rpm mode and check if concern is rpm related.
   - Example: A vibration is felt in the seat. Place the sensor on the console. Record the readings. Place the vibration sensor on the rear axle. Compare the readings. If the frequencies are the same, the axle is the problem component.

Vibrate Software®

Vibrate Software® (Rotunda tool number 215-00003) is a diagnostic aid which will assist in pinpointing the source of unacceptable vibrations. The engine's crankshaft is the point of reference for vibration diagnosis. Every rotating component will have an angular velocity that is faster, slower, or the same as the engine's crankshaft. Vibrate Software® calculates the angular velocity of each component and graphically represents these velocities on a computer screen and on a printed vibration worksheet. The following steps outline how Vibrate Software® helps diagnose a vibration concern:

- Enter the vehicle information. Vibrate will do all the calculations and display a graph showing tire, driveshaft and engine vibrations.
- Print a Vibration Worksheet graph. The printed graph is to be used during the road test.
- Road test the vehicle at the speed where the vibration is most noticeable. Record the vibration frequency (rpm) and the engine rpm on the worksheet graph. The point on the graph where the vibration frequency (rpm) reading and the engine rpm reading intersect indicates the specific component group causing the concern.
  - An EVA or equivalent tool capable of measuring vibration frequency and engine rpm will be needed.
- Provide pictures of diagnostic procedures to aid in testing components.

Combination EngineEAR/ChassisEAR

An electronic listening device used to quickly identify noise and the location under the chassis while the vehicle is being road tested. The ChassisEARs can identify the noise and location of damaged/worn wheel bearings, CV joints, brakes, springs, axle bearings or driveshaft carrier bearings.

EngineEAR Basic Unit

An electronic listening device used to detect even the faintest noises. The EngineEARs can detect the noise of damaged/worn bearings in generators, water pumps, A/C compressors and power steering pumps. They are also used to identify noisy lifters, exhaust manifold leaks, chipped gear teeth and for detecting wind noise. The EngineEAR has a sensing tip, amplifier, and headphones. The directional sensing tip is used to listen to the various components. Point the sensing tip at the suspect component and adjust the volume with the amplifier. Placing the tip in direct contact with a component will reveal structure-borne noise and vibrations, generated by or passing through, the component. Various volume levels can reveal different sounds.

Ultrasonic Leak Detector

The Ultrasonic Leak Detector is used to detect wind noises caused by leaks and gaps in areas where there is weather-stripping or other sealing material. It is also used to identify A/C leaks, vacuum leaks and evaporative emission noises. The Ultrasonic Leak Detector includes a multi-directional transmitter (operating in the ultrasonic range) and a hand-held detector. The transmitter is placed inside the vehicle. On the outside of the vehicle, the hand-held detector is used to sweep the area of the suspected leak. As the source of the leak is approached, a beeping sound is produced which increases in both speed and frequency.

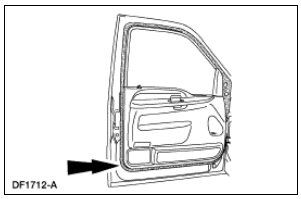
Squeak and Rattle Repair Kit

The squeak and rattle repair kit (Rotunda tool number 164-R4900) contains lubricants and self-adhesive materials that can be used to eliminate interior and exterior squeaks and rattles. The kit consists of the following materials:

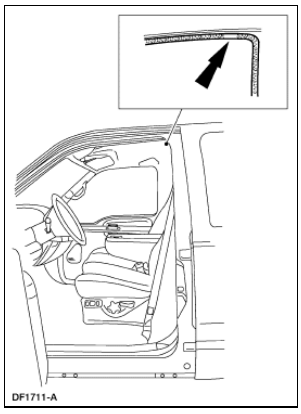
- PVC (soft foam) tape
- Urethane (hard foam) tape
- Flocked (black fuzzy) tape
- UHMW (frosted) tape
- Squeak and rattle oil tube
- Squeak and rattle grease tube

Tracing Powder

Tracing powder is used to check both the uniformity of contact and the tension of a seal against its sealing surface. These tests are usually done when a suspected air leak/noise appears to originate from the seal area or during the alignment and adjustment of a component to a weatherstrip. Tracing powder can be ordered from Crest Industries as ATR Leak Trace. Carry out the tracing powder test as follows:

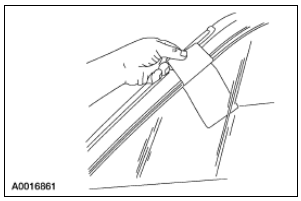


a. Clean the weatherstrip.
b. Spray the tracing powder on the mating surface only.
c. Close the door completely. Do not slam the door.
d. Open the door. An imprint is made where the weatherstrip contacted the mating surface seal. Gaps or a faint imprint will show where there is poor contact with the weatherstrip.



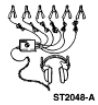
Index Card

Place an index card or a piece of paper between the weatherstrip and the sealing surface, then close the door. Slowly withdraw the index card or paper after the door is closed and check the amount of pressure on the weatherstrip. There should be a medium amount of resistance as it is withdrawn. Continue around the entire seal area. If there is little or no resistance, this indicates insufficient contact to form a good seal. At these points, the door, the glass, or the weatherstrip is out of alignment.



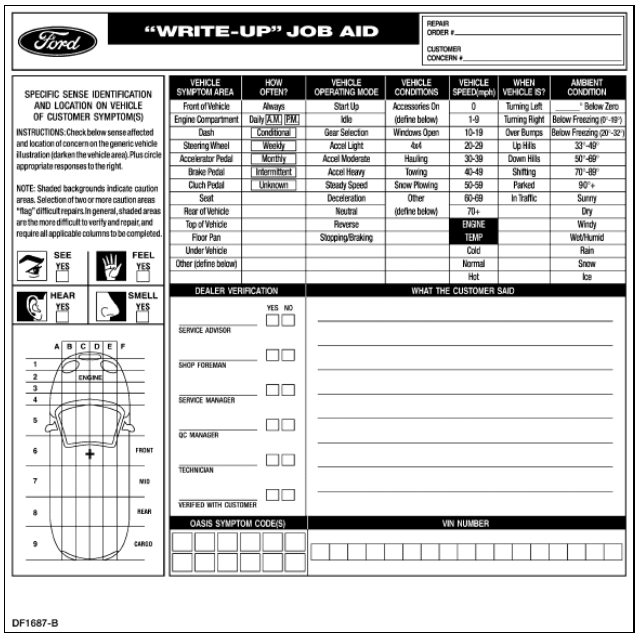
Noise, Vibration And Harshness (NVH)

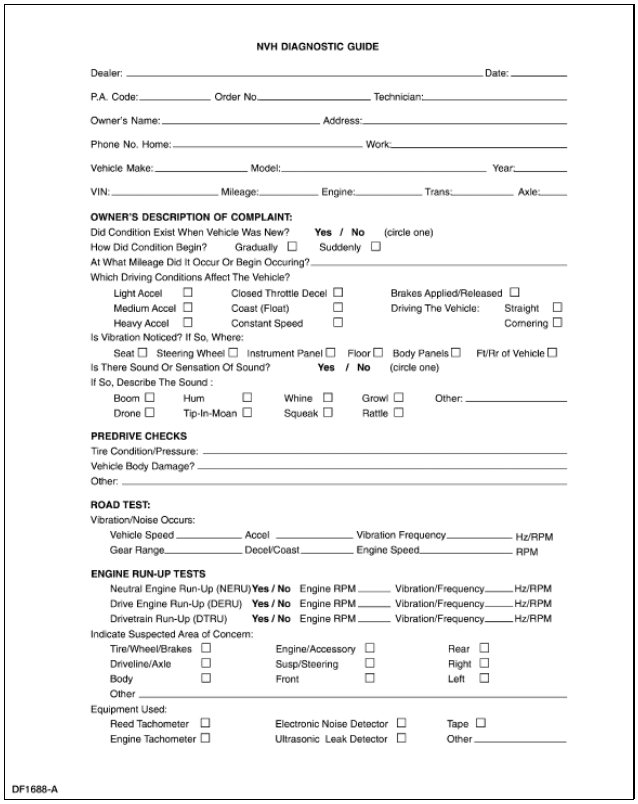
Special Tool(s)

 ST2048-A	ChassisEAR 107-R2102 or Equivalent
 ST2311-A	Vibration Analyzer 100-F027 (014-00344) or Equivalent
 ST2312-A	EngineEAR 107-R2100 or Equivalent
 ST2314-A	Ultrasonic Leak Detector 134-R0135 or Equivalent

To assist the service advisor and the technician, a Write-up Job Aid and an NVH Diagnostic Guide are included with this material. The Write-up Job Aid serves as a place to record all important symptom information. The NVH Diagnostic Guide serves as a place to record information reported on the Write-up Job Aid as well as data from the testing to be carried out.

To begin a successful diagnosis, fill out the NVH Diagnostic Guide, record the reported findings, then proceed to each of the numbered process steps to complete the diagnosis.





NVH DIAGNOSTIC GUIDE

Dealer: _____ Date: _____

P.A. Code: _____ Order No. _____ Technician: _____

Owner's Name: _____ Address: _____

Phone No. Home: _____ Work: _____

Vehicle Make: _____ Model: _____ Year: _____

VIN: _____ Mileage: _____ Engine: _____ Trans: _____ Axle: _____

OWNER'S DESCRIPTION OF COMPLAINT:

Did Condition Exist When Vehicle Was New? **Yes / No** (circle one)

How Did Condition Begin? Gradually ☐ Suddenly ☐

At What Mileage Did It Occur Or Begin Occuring? _____

Which Driving Conditions Affect The Vehicle?

Light Accel ☐ Closed Throttle Decel ☐ Brakes Applied/Released ☐

Medium Accel ☐ Coast (Float) ☐ Driving The Vehicle: Straight ☐

Heavy Accel ☐ Constant Speed ☐ Cornering ☐

Is Vibration Noticed? If So, Where:

Seat ☐ Steering Wheel ☐ Instrument Panel ☐ Floor ☐ Body Panels ☐ Ft/Rr of Vehicle ☐

Is There Sound Or Sensation Of Sound? **Yes / No** (circle one)

If So, Describe The Sound :

Boom ☐ Hum ☐ Whine ☐ Growl ☐ Other: _____

Drone ☐ Tip-In-Moan ☐ Squeak ☐ Rattle ☐

PREDRIVE CHECKS

Tire Condition/Pressure: _____

Vehicle Body Damage? _____

Other: _____

ROAD TEST:

Vibration/Noise Occurs:

Vehicle Speed _____ Accel _____ Vibration Frequency _____ Hz/RPM

Gear Range _____ Decel/Coast _____ Engine Speed _____ RPM

ENGINE RUN-UP TESTS

Neutral Engine Run-Up (NERU) **Yes / No** Engine RPM _____ Vibration/Frequency _____ Hz/RPM

Drive Engine Run-Up (DERU) **Yes / No** Engine RPM _____ Vibration/Frequency _____ Hz/RPM

Drivetrain Run-Up (DTRU) **Yes / No** Engine RPM _____ Vibration/Frequency _____ Hz/RPM

Indicate Suspected Area of Concern:

Tire/Wheel/Brakes ☐ Engine/Accessory ☐ Rear ☐

Driveline/Axle ☐ Susp/Steering ☐ Right ☐

Body ☐ Front ☐ Left ☐

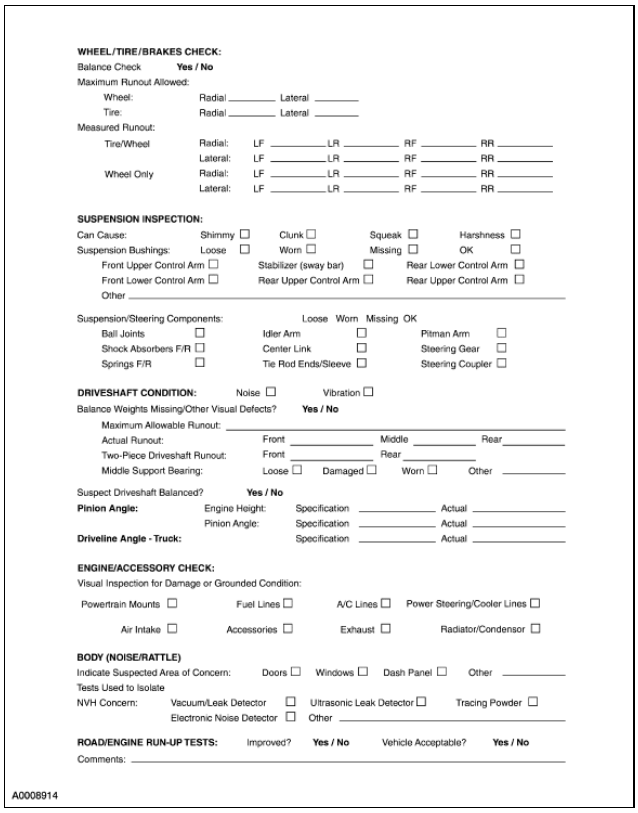
Other _____

Equipment Used:

Reed Tachometer ☐ Electronic Noise Detector ☐ Tape ☐

Engine Tachometer ☐ Ultrasonic Leak Detector ☐ Other _____

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WHEEL/TIRE/BRAKES CHECK:

Balance Check **Yes / No**

Maximum Runout Allowed:

Wheel: Radial _____ Lateral _____

Tire: Radial _____ Lateral _____

Measured Runout:

Tire/Wheel Radial: LF _____ LR _____ RF _____ RR _____

Lateral: LF _____ LR _____ RF _____ RR _____

Wheel Only Radial: LF _____ LR _____ RF _____ RR _____

Lateral: LF _____ LR _____ RF _____ RR _____

SUSPENSION INSPECTION:

Can Cause: Shimmy ☐ Clunk ☐ Squeak ☐ Harshness ☐

Suspension Bushings: Loose ☐ Worn ☐ Missing ☐ OK ☐

Front Upper Control Arm ☐ Stabilizer (sway bar) ☐ Rear Lower Control Arm ☐

Front Lower Control Arm ☐ Rear Upper Control Arm ☐ Rear Upper Control Arm ☐

Other _____

Suspension/Steering Components: Loose Worn Missing OK

Ball Joints ☐ Idler Arm ☐ Pitman Arm ☐

Shock Absorbers F/R ☐ Center Link ☐ Steering Gear ☐

Springs F/R ☐ Tie Rod Ends/Sleeve ☐ Steering Coupler ☐

DRIVESHAFT CONDITION: Noise ☐ Vibration ☐

Balance Weights Missing/Other Visual Defects? **Yes / No**

Maximum Allowable Runout: _____

Actual Runout: Front _____ Middle _____ Rear _____

Two-Piece Driveshaft Runout: Front _____ Rear _____

Middle Support Bearing: Loose ☐ Damaged ☐ Worn ☐ Other _____

Suspect Driveshaft Balanced? **Yes / No**

Pinion Angle: Engine Height: Specification _____ Actual _____

Pinion Angle: Specification _____ Actual _____

Driveline Angle - Truck: Specification _____ Actual _____

ENGINE/ACCESSORY CHECK:

Visual Inspection for Damage or Grounded Condition:

Powertrain Mounts ☐ Fuel Lines ☐ A/C Lines ☐ Power Steering/Cooler Lines ☐

Air Intake ☐ Accessories ☐ Exhaust ☐ Radiator/Condensor ☐

BODY (NOISE/RATTLE)

Indicate Suspected Area of Concern: Doors ☐ Windows ☐ Dash Panel ☐ Other _____

Tests Used to Isolate

NVH Concern: Vacuum/Leak Detector ☐ Ultrasonic Leak Detector ☐ Tracing Powder ☐

Electronic Noise Detector ☐ Other _____

ROAD/ENGINE RUN-UP TESTS: Improved? **Yes / No** Vehicle Acceptable? **Yes / No**

Comments: _____

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1: Customer Interview

The diagnostic process starts with the customer interview. The service advisor must obtain as much information as possible about the concern and take a test drive with the customer. There are many ways a customer will describe NVH concerns and this will help minimize confusion arising from descriptive language differences. It is important that the concern is correctly interpreted and the customer descriptions are

recorded. During the interview, ask the following questions:

- When was the concern first noticed?
- Did the concern appear suddenly or gradually?
- Did any abnormal occurrence coincide with or proceed its appearance?

Use the information gained from the customer to accurately begin the diagnostic process.

2: Pre-Drive Check

It is important to do a pre-drive check before road testing the vehicle. A pre-drive check verifies that the vehicle is relatively safe to drive and eliminates any obvious faults on the vehicle.

The pre-drive check consists of a brief visual inspection. During this brief inspection, take note of anything that will compromise safety during the road test and make those repairs or adjustments before taking the vehicle on the road.

3: Preparing for the Road Test

Observe the following when preparing for the road test:

- Review the information recorded on the NVH Diagnostic Guide. It is important to know the specific concern the customer has with the vehicle.
- Do not be misled by the reported location of the noise or vibration. The cause can actually be some distance away, transferred from another part of the vehicle.
- Remember that the vibrating source component (originator) may only generate a small vibration. This small vibration can in turn cause a larger vibration or noise to emanate from another receiving component (reactor), due to contact with other components (transfer path).
- Conduct the road test on a quiet street where it is safe to duplicate the vibration/noise. The ideal testing route is an open, low-traffic area where it is possible to operate the vehicle at the speed in which the condition occurs.
- If possible, lower the radio antenna in order to minimize turbulence. Identify anything that could potentially make noise or be a source of wind noise. Inspect the vehicle for add-on items that create vibration/noise. Turn off the radio and the heating and cooling system blower.
- The engine speed is an important factor in arriving at a final conclusion. Therefore, connect an accurate tachometer to the engine, even if the vehicle has a tachometer. Use a tachometer that has clearly defined increments of less than 50 rpm. This ensures an exact engine speed reading.

4: Verify the Customer Concern

Verify the customer concern by carrying out a road test, an engine run-up test, or both.

The decision to carry out a road test, an engine run-up test, or both depends on the type of NVH concern. A road test may be necessary if the symptom relates to the suspension system or is sensitive to torque. A drive engine run-up (DERU) or a neutral engine run-up (NERU) test identifies noises and vibrations relating to engine and drivetrain rpm. Remember, a condition will not always be identifiable by carrying out these tests, however, they will eliminate many possibilities if carried out correctly.

5: Road Test

NOTE: It may be necessary to have the customer ride along or drive the vehicle to point out the concern. During the road test, take into consideration the customer's driving habits and the driving conditions. The customer's concern just may be an acceptable operating condition for that vehicle.

The following is a brief overview of each test in the order in which it appears. A review of this information helps to quickly identify the most appropriate process necessary to make a successful diagnosis. After reviewing this information, select and carry out the appropriate test(s), proceeding to the next step of this process.

- The Slow Acceleration Test is normally the first test to carry out when identifying an NVH concern, especially when a road test with the customer is not possible.
- The Heavy Acceleration Test helps to determine if the concern is torque-related.
- The Neutral Coast Down Speed Test helps to determine if the concern is vehicle speed-related.
- The Downshift Speed Test helps to determine if the concern is engine speed-related.
- The Steering Input Test helps to determine how the wheel bearings and other suspension components contribute to a vehicle speed-related concern.
- The Brake Test helps to identify vibrations or noise that are brake related.
- The Road Test Over Bumps helps isolate a noise that occurs when driving over a rough or bumpy surface.
- The Engine Run-Up Tests consist of the Neutral Run-up Test and the Engine Load Test. These tests help to determine if the concern is engine speed-related.
- The Neutral Run-up Test is used as a follow-up test to the Downshift Speed Test when the concern occurs at idle.
- The Engine Load Test helps to identify vibration/noise sensitive to engine load or torque. It also helps to reproduce engine speed-related concerns that cannot be duplicated when carrying out the Neutral Run-up Test or the Neutral Coast Down Test.
- The Engine Accessory Test helps to locate faulty belts and accessories that cause engine speed-related concerns.
- The Vehicle Cold Soak Procedure helps to identify concerns occurring during initial start-up and when an extended time lapse occurs between vehicle usage.

Slow Acceleration Test

To carry out this test, proceed as follows:

- Slowly accelerate to the speed where the reported concern occurs. Note the vehicle speed, the engine rpm and, if possible, determine the vibration frequency.
- Attempt to identify from what part of the vehicle the concern is coming.
- Attempt to identify the source of the concern.
- Proceed as necessary.

Heavy Acceleration Test

To carry out this test, proceed as follows:

- Accelerate hard from 0-64 km/h (0-40 mph).
- Decelerate in a lower gear.
- The concern is torque related if duplicated while carrying out this test.
- Proceed as necessary.

Neutral Coast Down Speed Test

To carry out this test, proceed as follows:

- Drive at a higher rate of speed than where the concern occurred when carrying out the Slow Acceleration Test.
- Place the transmission in NEUTRAL and coast down past the speed where the concern occurs.
- The concern is vehicle speed-related if duplicated while carrying out this test. This eliminates the engine and the torque converter as sources.
- If the concern was not duplicated while carrying out this test, carry out the Downshift Speed Test to verify if the concern is engine speed related.
- Proceed as necessary.

Downshift Speed Test

To carry out this test, proceed as follows:

- Shift into a lower gear than the gear used when carrying out the Slow Acceleration Test.
- Drive at the engine rpm where the concern occurs.
- The concern is engine speed related if duplicated while carrying out this test. This eliminates the tires, wheels, brakes and the suspension components as sources.
- If necessary, repeat this test using other gears and NEUTRAL to verify the results.
- Proceed as necessary.

Steering Input Test

To carry out this test, proceed as follows:

- Drive at the speed where the concern occurs, while making sweeping turns in both directions.
- If the concern goes away or gets worse, the wheel bearings, hubs, U-joints (contained in the axles of 4WD applications), and tire tread wear are all possible sources.
- Proceed as necessary.

Brake Test

To carry out this test, proceed as follows:

- Warm the brakes by slowing the vehicle a few times from 80 32 km/h (50 20 mph) using light braking applications. At highway speeds of 89 97 km/h (50 60 mph), apply the brake using a light pedal force.
- Accelerate to 89 97 km/h (55 60 mph).
- Lightly apply the brakes and slow the vehicle to 30 km/h (20 mph).
- A brake vibration noise can be felt in the steering wheel, seat or brake pedal. A brake noise can be heard upon brake application and diminish when the brake is released.

Road Test Over Bumps

To carry out this test, proceed as follows:

- Drive the vehicle over a bump or rough surface one wheel at a time to determine if the noise is coming from the front or the back and the left or the right side of the vehicle.
- Proceed as necessary.

Neutral Engine Run-up (NERU) Test

To carry out this test, proceed as follows:

- Install a tachometer.

- Increase the engine rpm up from an idle to approximately 4000 rpm while in PARK on front wheel drive vehicles with automatic transmissions, or NEUTRAL for all other vehicles. Note the engine rpm and, if possible, determine the vibration frequency.
- Attempt to identify what part of the vehicle the concern is coming from.
- Attempt to identify the source of the concern.
- Proceed as necessary.

Drive Engine Run-up (DERU) Load Test

To carry out this test, proceed as follows:

- **⚠ WARNING: Block the front and rear wheels, and apply the parking brake and the service brake, or injury to personnel can result.**

  ⚠ CAUTION: Do not carry out the Engine Load Test for more than five seconds or damage to the transmission or transaxle can result.

  Block the front and rear wheels.
- Apply the parking brake and the service brake.
- Install a tachometer.
- Shift the transmission into DRIVE, and increase and decrease the engine rpm between an idle to approximately 2000 rpm. Note the engine rpm and, if possible, determine the vibration frequency.
- Repeat the test in REVERSE.
- If the vibration/noise is duplicated when carrying out this test, inspect the engine and transmission or transaxle mounts.
- If the concern is definitely engine speed-related, carry out the Engine Accessory Test to narrow down the source.
- Proceed as necessary.

Engine Accessory Test

To carry out this test, proceed as follows:

- **⚠ WARNING: Block the front and rear wheels, and apply the parking brake and the service brake, or injury to personnel can result.**

  ⚠ CAUTION: Limit engine running time to one minute or less with belts removed or serious engine damage will result.

  NOTE: A serpentine drive belt decreases the usefulness of this test. In these cases, use a vibration analyzer, such as the VA, to pinpoint accessory vibrations. An electronic listening device, such as an EngineEAR, will also help to identify noises from specific accessories.

  Remove the accessory drive belts.
- Increase the engine rpm to where the concern occurs.
- If the vibration/noise is duplicated when carrying out this test, the belts and accessories are not sources.
- If the vibration/noise was not duplicated when carrying out this test, install each accessory belt, one at a time, to locate the source.

Vehicle Cold Soak Procedure

To carry out this procedure, proceed as follows:

- Test preparations include matching customer conditions (if known). If not known, document the test conditions: gear selection and engine rpm. Monitor the vibration/noise duration with a watch for up to three minutes.
- Park the vehicle where testing will occur. The vehicle must remain at or below the concern temperature (if known) for 6-8 hours.
- Before starting the engine, conduct a visual inspection under the hood.
- Turn the key on, but do not start the engine. Listen for the fuel pump, anti-lock brake system (ABS) and air suspension system noises.
- Start the engine.
- ⚠ **CAUTION: Never probe moving parts.**

  Isolate the vibration/noise by carefully listening. Move around the vehicle while listening to find the general location of the vibration/noise. Then, search for a more precise location by using a stethoscope or EngineEAR.
- Refer to Idle Noise/Vibration in the Symptom Chart to assist with the diagnosis.

6: Check OASIS/TSBs/Repair History

After verifying the customer concern, check for OASIS reports, TSBs and the vehicle repair history for related concerns. If information relating to a diagnosis/repair is found, carry out the procedure(s) specified in that information.

If no information is available from these sources, carry out the vehicle preliminary inspection to eliminate any obvious faults.

7: Diagnostic Procedure

Qualifying the concern by the particular sensation present can help narrow down the concern. Always use the "symptom" to "system" to "component" to "cause" diagnosis technique. This diagnostic method divides the problem into related areas to correct the customer concern.

- Verify the "symptom".
- Determine which "system(s)" can cause the "symptom".
  - ♦ If a vibration concern is vehicle speed related, the tire and wheel rpm/frequency or driveshaft frequency should be calculated.
  - ♦ If a vibration concern is engine speed related, the engine, engine accessory or engine firing frequencies should be calculated.
- After determining the "system", use the diagnostic tools to identify the worn or damaged "components".
- After identifying the "components", try to find the "cause" of the failure.

Once the concern is narrowed down to a symptom/condition, proceed to NVH Condition and Symptom Categories.

NVH Condition and Symptom Categories

A good diagnostic process is a logical sequence of steps that lead to the identification of a causal system. Use the condition and symptom categories as follows:

- Identify the operating condition that the vehicle is exhibiting.
- Match the operating condition to the symptom.

- Verify the symptom.
- Identify which category or system could cause the symptom.
- Refer to the diagnostic symptom chart that is referred to.

Operating Condition Vehicle is Not Moving

1. Static operation
    - Noise occurs during component/system functioning. GO to Symptom Chart Squeak and Rattle .

2. While cranking
    1. Grinding or whine, differential ring gear or starter motor pinion noise. GO to Symptom Chart Engine Noise/Vibration .
    2. Rattle. Exhaust hanger, exhaust heat shield or A/C line noise. GO to Symptom Chart Squeak and Rattle .
    3. Vibration. Acceptable condition.

3. At idle
    - Idle noise. GO to Symptom Chart Idle Noise/Vibration .
    - Idle vibration or shake. GO to Symptom Chart Idle Noise/Vibration .

4. During Gear Selection
    1. Vehicle parked on a steep incline. Acceptable noise.
    2. Vehicle parked on a flat surface. GO to Symptom Chart Driveline Noise/Vibration .
    3. Vehicle with a manual transmission. GO to Symptom Chart Transmission (Manual) and Transfer Case Noise/Vibration .

Operating Condition Vehicle is Moving

1. Depends more on how the vehicle is operated
    1. Speed related
        - ♦ Related to vehicle speed
            - ♦ Pitch increases with vehicle speed. GO to Symptom Chart Tire Noise/Vibration .
            - ♦ Noise occurs at specific vehicle speed. A high-pitched noise (whine). GO to Symptom Chart Driveline Noise/Vibration .
            - ♦ Loudness proportional to vehicle speed. Low-frequency noise at high speeds, noise and loudness increase with speed. GO to Symptom Chart Driveline Noise/Vibration .
            - ♦ A low-pitched noise (drumming). GO to Symptom Chart Engine Noise/Vibration .
            - ♦ Vibration occurs at a particular speed (mph) regardless of acceleration or deceleration. GO to Symptom Chart Tire Noise/Vibration .
            - ♦ Noise varies with wind/vehicle speed and direction. GO to Symptom Chart Air Leak and Wind Noise .
        - ♦ Related to engine speed.
            - ♦ Noise varies with engine rpm. GO to Symptom Chart Engine Noise/Vibration .
            - ♦ Vibration occurs at a particular speed (mph) regardless of engine speed (rpm).
    2. Acceleration
        - ♦ Wide open throttle (WOT)
            - ♦ Engine induced contact between components. Inspect and repair as necessary.

- Noise is continuous throughout WOT. Exhaust system or engine ground out. GO to Symptom Chart Engine Noise/Vibration .
- Light/moderate acceleration
  - Tip-in moan. Engine/exhaust noise. GO to Symptom Chart Engine Noise/Vibration .
  - Knock-type noise. GO to Symptom Chart Engine Noise/Vibration .
  - Driveline shudder. GO to Symptom Chart Driveline Noise/Vibration .
  - Engine vibration. GO to Symptom Chart Engine Noise/Vibration .

3. Turning noise. GO to Symptom Chart Steering Noise/Vibration .
4. Braking
   - Clicking sound is signaling ABS is active. Acceptable ABS sound.
   - A continuous grinding/squeal. GO to Symptom Chart Brake Noise/Vibration .
   - Brake vibration/shudder. GO to Symptom Chart Brake Noise/Vibration .
5. Clutching
   - A noise occurring during clutch operation. GO to Symptom Chart Transmission (Manual) and Transfer Case Noise/Vibration .
   - Vibration. GO to Symptom Chart Transmission (Manual) and Transfer Case Noise/Vibration .
6. Shifting
   - Noise or vibration condition related to the transmission (automatic). GO to Symptom Chart Transmission (Automatic) Noise/Vibration .
   - Noise or vibration related to the transmission (manual). GO to Symptom Chart Transmission (Manual) and Transfer Case Noise/Vibration .
7. Engaged in four-wheel drive. GO to Symptom Chart Transmission (Manual) and Transfer Case Noise/Vibration .
8. Cruising speeds
   - Accelerator pedal vibration. GO to Symptom Chart Engine Noise/Vibration .
   - Driveline vibration. GO to Symptom Chart Driveline Noise/Vibration .
   - A shimmy or shake. GO to Symptom Chart Tire Noise/Vibration .
9. Driving at low/medium speeds
   - A wobble or shudder. GO to Symptom Chart Tire Noise/Vibration .

2. Depends more on where the vehicle is operated
   1. Bump/pothole, rough road or smooth road. GO to Symptom Chart Suspension Noise/Vibration .
      - Noise is random or intermittent occurring from road irregularities. GO to Symptom Chart Squeak and Rattle .
      - Noise or vibration changes from one road surface to another. Normal sound changes.
      - Noise or vibration associated with a hard/firm ride. GO to Symptom Chart Suspension Noise/Vibration .

Symptom Charts

Symptom Chart Air Leak and Wind Noise

Symptom Chart Brake Noise/Vibration

Symptom Chart Driveline Noise/Vibration

Symptom Chart Engine Noise/Vibration

Symptom Chart Idle Noise/Vibration

Symptom Chart Squeak and Rattle

Symptom Chart Steering Noise/Vibration

Symptom Chart Suspension Noise/Vibration

Symptom Chart Tire Noise/Vibration

Symptom Chart Transmission (Manual) Noise/Vibration

Symptom Chart Transmission (Automatic) Noise/Vibration

Pinpoint Tests

The pinpoint tests are a step-by-step diagnostic process designed to determine the cause of a condition. It may not always be necessary to follow a pinpoint test to its conclusion. Carry out only the steps necessary to correct the condition. Then, test the system for normal operation. Sometimes, it is necessary to remove various vehicle components to gain access to the component requiring testing. For additional information, REFER to the appropriate Workshop Manual section for removal and installation procedures. Reinstall all components after verifying system operation is normal.

PINPOINT TEST A: BRAKE VIBRATION/SHUDDER

PINPOINT TEST B: ENGINE TICKING NOISE

PINPOINT TEST C: ACCESSORY DRIVE BEARING HOOT

PINPOINT TEST D: POWER STEERING MOAN

PINPOINT TEST E: ENGINE DRIVEN COOLING FAN MOAN

PINPOINT TEST F: DRUMMING NOISE

PINPOINT TEST G: ENGINE TICKING, KNOCKING OR CONTINUOUS RATTLE

PINPOINT TEST H: FRONT SUSPENSION NOISE

PINPOINT TEST I: REAR SUSPENSION NOISE

PINPOINT TEST J: WHEEL AND TIRE

PINPOINT TEST K: HIGH SPEED SHAKE OR SHIMMY

PINPOINT TEST L: CLUTCH VIBRATION

Component Tests

Idle Air Control (IAC) Valve

1. Open the hood.
2. **NOTE:** Key symptom is elevated idle speed while noise is occurring.

   NOTE: "Snapping" the throttle can induce the noise.

   Verify the condition by operating the vehicle for a short time.
3. Inspect the IAC valve. If physical evidence of contamination exists, install a new IAC valve.
4. While the noise is occurring, either place an EngineEAR probe near the IAC valve and the inlet tube, or create a 6.35 mm (0.25 in)-12.7 mm (0.50 in) air gap between the inlet tube and the clean air tube. If the IAC valve is making the noise, install a new IAC valve.
5. Test the vehicle for normal operation.

Steering Gear Grunt/Shudder Test

1. Start and run the vehicle to operating temperature.
2. Set engine idle speed to 1200 rpm.
3. ⚠ **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

   Rotate the steering wheel to the RH stop, then turn the steering wheel 90° back from that position. Turn the steering wheel slowly in a 15° to 30° arc.
4. Turn the steering wheel another 90°. Turn the steering wheel slowly in a 15° to 30° arc.
5. Repeat the test with power steering fluid at different temperatures.
6. If a light grunt is heard or a low (50-200 Hz) shudder is present, this is a normal steering system condition.
7. If a loud grunt is heard, or strong shudder is felt, fill and purge the power steering system.

Checking Tooth Contact Pattern and Condition of the Ring and Pinion

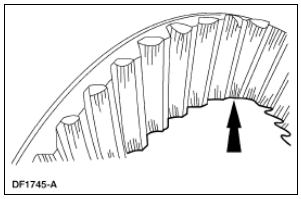
There are two basic types of conditions that will produce ring and pinion noise. The first type is a howl or chuckle produced by broken, cracked, chipped, scored or forcibly damaged gear teeth and is usually quite audible over the entire speed range. The second type of ring and pinion noise pertains to the mesh pattern of the gear pattern. This gear noise can be recognized as it produces a cycling pitch or whine. Ring and pinion noise tends to peak in a narrow speed range or ranges, and will tend to remain constant in pitch.

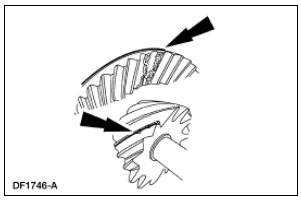
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Drain the axle lubricant. For additional information, refer to Section 205-02 .

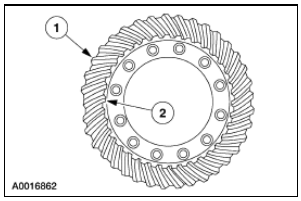
3. Remove the carrier assembly or the axle housing cover depending on the axle type. Refer to Section 205-02 .

4. Inspect the gear set for scoring or damage.





5. In the following steps, the movement of the contact pattern along the length is indicated as toward the" heel" or "toe" of the differential ring gear.

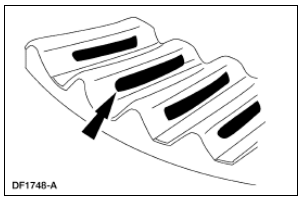


Item	Description
1	Heel
2	Toe

6. Apply a marking compound to a third of the gear teeth on the differential ring gear. Rotate the differential ring gear several complete turns in both directions until a good, clear tooth pattern is obtained. Inspect the contact patterns on the ring gear teeth.

7. A good contact pattern should be centered on the tooth. It can also be slightly toward the toe. There should always be some clearance between the contact pattern and the top of the tooth.

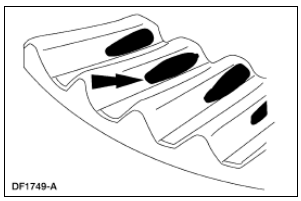
- Tooth contact pattern shown on the drive side of the gear teeth.



8. A high, thick contact pattern that is worn more toward the toe.

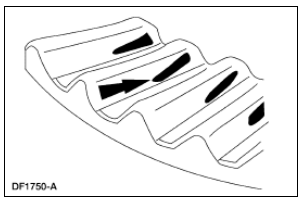
- Tooth contact pattern shown on the drive side of the gear teeth.

- The high contact pattern indicates that the drive pinion is not installed deep enough into the carrier.
- The differential ring gear backlash is correct, a thinner drive pinion shim is needed. A decrease will move the drive pinion toward the differential ring gear.



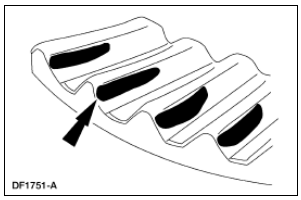
9. A high, thin contact pattern that is worn toward the toe.

- Tooth contact pattern shown on the drive side of the gear teeth.
- The drive pinion depth is correct. Increase the differential ring gear backlash.



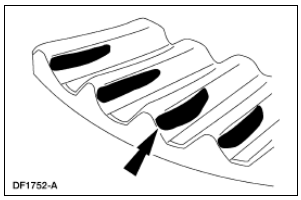
10. A contact pattern that is worn in the center of the differential ring gear tooth toward the heel.

- Tooth contact pattern shown on the drive side of the gear teeth.
- The low contact pattern indicates that the drive pinion is installed too deep into the carrier.
- The differential ring gear backlash is correct. A thicker drive pinion shim is needed.



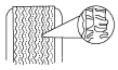
11. A contact pattern that is worn at the top of the differential ring gear tooth toward the heel.

- Tooth contact pattern shown on the drive side of the gear teeth.
- The pinion gear depth is correct. Decrease the differential ring gear backlash.



Tire Wear Patterns and frequency calculations

Tire Wear Chart

TIRE WEAR	CONDITION	POSSIBLE CAUSES
	• Rapid wear at both shoulders.	• Tires underinflated. • Worn suspension components. • Excessive cornering speeds. • Lack of rotation.
	• Rapid wear at the center.	• Tires overinflated. • Lack of rotation. • Excessive toe on drive wheels. • Heavy acceleration on drive wheels.
	• Wear at one shoulder.	• Toe adjustment out of specification. • Camber out of specification. • Damaged strut. • Damaged lower control arm.
	• Feather edges.	• Toe adjustment out of specification. • Damaged or worn tie rods. • Damaged spindle or knuckle.
	• Bald spots or cupping.	• Unbalanced wheel. • Excessive radial runout. • Worn strut or shock absorber.
	• Tire scalloped.	• Toe adjustment out of specification. • Camber out of specification. • Worn or damaged suspension components.
	• Wear pattern - FWD vehicles.	• Excessive toe on non-drive wheels. • Lack of rotation.
	• Wear pattern - FWD vehicles. Edge of thread blocks worn.	• Excessive toe on non-drive wheels. • Lack of rotation.

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Wheel and tire NVH concerns are directly related to vehicle speed and are not generally affected by acceleration, coasting or decelerating. Also, out-of-balance wheel and tires can vibrate at more than one speed. A vibration that is affected by the engine rpm, or is eliminated by placing the transmission in NEUTRAL is not related to the tire and wheel. As a general rule, tire and wheel vibrations felt in the steering wheel are related to the front tire and wheel assemblies. Vibrations felt in the seat or floor are related to the rear tire and wheel assemblies. This can initially isolate a concern to the front or rear.

Careful attention must be paid to the tire and wheels. There are several symptoms that can be caused by damaged or worn tire and wheels. Carry out a careful visual inspection of the tires and wheel assemblies. Spin the tires slowly and watch for signs of lateral or radial runout. Refer to the tire wear chart to determine the tire wear conditions and actions.

For a vibration concern, use the vehicle speed to determine tire/wheel frequency and rpm. Calculate tire and wheel rpm and frequency by carrying out and following:

- Measure the diameter of the tire.
- Record the speed at which the vibration occurs.
- Obtain the corresponding tire and wheel rpm and frequency from the Tire Speed and Frequency Chart.
    - ♦ If the vehicle speed is not listed, divide the vehicle speed at which the vibration occurs by 16 km/h (10 mph). Multiply that number by 16 km/h (10 mph) tire rpm listed for that tire diameter in the chart. Then divide that number by 60. For example: a 40 mph vibration with 835 mm (33 in) tires. 40 ÷ 10 = 4. Multiply 4 by 105 = 420 rpm. Divide 420 rpm by 60 seconds = 7 Hz at 40 mph.

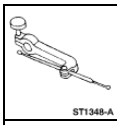
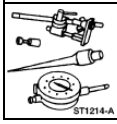
Tire Speed and Frequency Chart

Tire Diameter	Tire RPM/Hz	Tire RPM/Hz	Tire RPM/Hz	Tire RPM/Hz

mm (inch)	@ 16 km/h (10 mph)	@ 80 km/h (50 mph)	@ 97 km/h (60 mph)	@ 113 km/h (70 mph)
483 (19)	182	910/15	1092/18	1274/21
508 (20)	173	865/14	1038/17	1211/20
533 (21)	165	825/14	990/16	1155/19
560 (22)	158	790/13	948/16	1106/18
585 (23)	151	755/13	906/15	1057/18
610 (24)	145	725/12	870/14	1015/17
635 (25)	139	695/12	834/14	973/16
660 (26)	134	670/11	804/13	938/16
685 (27)	129	645/11	774/13	903/15
710 (28)	124	620/10	744/12	868/14
735 (29)	119	595/10	714/12	833/14
760 (30)	115	575/10	690/11	805/13
785 (31)	111	555/9	666/11	777/13
810 (32)	108	540/9	648/11	756/13
835 (33)	105	525/9	630/10	735/12
864 (34)	102	510/8	612/10	714/12

Brake Disc Machining

Special Tool(s)

 ST1348-A	Gauge, Clutch Housing 308-021 (T75L-4201-A)
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

Material

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA or equivalent	ESE-M12A4-A

⚠ WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

⚠ CAUTION: Do not install brake discs that are less than the minimum thickness specified. Do not machine a brake disc below the minimum thickness specification.

1. Check wheel bearing end-play and correct as necessary.

2. **NOTE:** Begin at the front of the vehicle unless the vibration has been isolated to the rear.

   Remove the tire and wheel assembly.

3. Remove the brake caliper and the brake caliper anchor plate. Refer to the appropriate section in Group 206 for the procedure.

4. Inspect the brake linings. Install new brake linings if below specification. For additional information, refer to the appropriate brake section.

5. Measure and record the brake disc thickness. Install a new brake disc if the thickness after machining will be at or below specification. The specification is molded into the brake disc.
   - Do not machine a new brake disc.

6. For vehicles with a two-piece hub and brake disc assembly:
   - Match-mark before disassembly.
   - Remove the brake disc.
   - Clean the hub and brake disc mounting surfaces with metal surface cleaner.

- Using a die grinder with a mild abrasive (Scotch Brite® type), remove any rust or corrosion from the hub and brake disc mounting surfaces.
- Align the match-marks and reinstall the brake disc on the hub.

7. ⚠ **CAUTION: Do not use a bench lathe to machine brake discs.**

   NOTE: The depth of cut must be between 0.10 and 0.20 mm (0.004 and 0.008 inch). Lighter cuts will cause heat and wear. Heavier cuts will cause poor brake disc surface finish.

   Using an on-car brake lathe, machine the brake discs. Follow the manufacturer's instructions. After machining, make sure the brake disc still meets the thickness specification.

8. Using the special tools, verify that the brake disc lateral runout is now within specification. For additional information, refer to Section 206-00 .

9. Remove the special tool hub adapter.

10. Remove any remaining metal chips from the machining operation.

11. For vehicles with a two-piece hub and brake disc assembly:
    - Remove the brake disc from the hub.
    - Remove any remaining metal chips from hub and brake disc mounting surfaces and from the ABS sensor.
    - Apply a liberal amount of lubricant to the hub flange, pilot area and to the brake disc-to-hub mounting surface.
    - Using the match marks, mount the brake disc on the hub.

12. Install the brake caliper anchor plate and the brake caliper.

13. Install the tire and wheel assembly.

14. Test the system for normal operation.

Powertrain/Drivetrain Mount Neutralizing

⚠ WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.

1. Raise and support the vehicle.
2. Loosen, but do not remove, the powertrain/drivetrain mount fasteners.
3. Lower the vehicle.
4. **⚠ CAUTION: Do not twist or strain the powertrain/drivetrain mounts.**

   Move the vehicle in forward and reverse 0.6-1.2 meters (2-4 ft).
5. Raise and support the vehicle.
6. Tighten the powertrain/drivetrain mount fasteners.
7. Lower the vehicle.
8. Test the system for normal operation.

Exhaust System Neutralizing

⚠ WARNING: Exhaust gases contain carbon monoxide, which is harmful to health and potentially lethal. Repair exhaust system leaks immediately. Never operate the engine in an enclosed area.

⚠ WARNING: Exhaust system components are hot.

NOTE: Neutralize the exhaust system to relieve strain on mounts which can be sufficiently bound up to transmit vibration as if grounded.

1. **⚠ WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   ⚠ CAUTION: Make sure the system is warmed up to normal operating temperature, as thermal expansion can be the cause of a strain problem.

   Raise and support the vehicle.

2. Loosen all exhaust hanger attachments and reposition the hangers until they hang free and straight.

3. Loosen all exhaust flange joints.

4. Place a stand to support the muffler parallel to the vehicle frame with the muffler pipe bracket free of stress.

5. Tighten the muffler connection.

6. Tighten all the exhaust hanger clamps and flanges (tighten the exhaust manifold flange joint last).
   - Verify there is adequate clearance to prevent grounding at any point in the system. Make sure that the catalytic converter and heat shield do not contact the frame rails.
   - After neutralization, the rubber in the exhaust hangers should show some flexibility when movement is applied to the exhaust system.
   - With the exhaust system installed securely and cooled, the rear hanger should be angled forward.

7. Lower the vehicle.

8. Test the exhaust system for normal operation.

Wheel Bearing Check

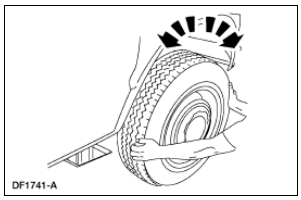
1. ⚠ **WARNING: The electrical power to the air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. This can be accomplished by turning off the air suspension switch. Failure to do so can result in unexpected inflation or deflation of the air springs, which can result in shifting of the vehicle during these operations.**

   Raise the vehicle until the front tires are off the floor.

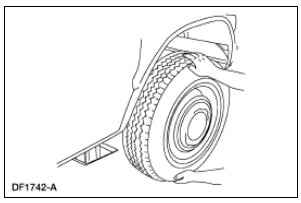
   - Make sure the wheels are in a straight forward position.

2. **NOTE:** Make sure the wheel rotates freely and that the brake pads are retraced sufficiently to allow free movement of the tire and wheel assembly.

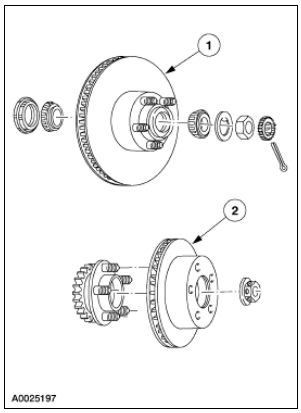
   Spin the tire by hand to check the wheel bearings for roughness.



3. Grip each front tire at the top and bottom and move the wheel inward and outward while lifting the weight of the tire off the front wheel bearing.



4. If the tire and wheel (hub) is loose on the spindle, does not rotate freely, or has a rough feeling when spun, carry out one of the following:
   1. On vehicles with inner and outer bearings, inspect the bearings and cups for wear or damage. Adjust or install new bearings and cups as necessary.
   2. On vehicles with one sealed bearing, install a new wheel hub.



General Specifications

Item	Specification
Adhesives	
Weatherstrip Adhesive E8AZ-19552-A	ESB-M2G14-A
Lubricants	
Silicone Lubricant F7AZ-19G208-BA	ESR-M13P4-A
Sealers	
Liquid Butyl Sealer F8AZ-19554-CA	ESB-M4G162-A
3M Strip Caulk-Black 051135-08578	WSB-M4G32-C
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4

Body

Body and Sheet Metal

The body:

- is a uni-body open cowl structure.
- is constructed of a monocoque, lightweight, all-steel material with removable bolted hood (16612), front fenders (16005), doors, and luggage compartment lid.

Insulation

Insulation is comprised of urethane, PVC, and recycled felt. Insulation is installed:

- under the roof panel.
- above and below the instrument panel.
- on the cowl sides.
- over the front and rear floor areas.
- in the B-pillar and C-pillar sections.

Body Sealer Types And Applications

Liquid Butyl Sealer

Liquid Butyl Sealer F8AZ-19554-CA or equivalent meeting Ford Specification ESB-M4G162-A:

- does not run.
- is fast drying.
- remains semi-elastic.
- can be used for seam sealing on the floor pan, wheelhouse, door openings, and drip rails.

Caulking Cord

3M Strip Caulk-Black 051135-08578 or equivalent meeting Ford specification WSB-M4G32-C:

- is a heavy-bodied, plastic base with a filler.
- is commonly known as perma-gum.
- is used on spot-welds holes and between surfaces not sealed with a gasket.

Weatherstrip Adhesive

Weatherstrip Adhesive E8AZ-19552-A or equivalent meeting Ford specification ESB-M2G14-A:

- is a quick drying, strong adhesive designed to hold weatherstripping onto all body panels and surrounding metal.

Silicone Lubricant

Silicone Lubricant F7AZ-19G208-BA meeting Ford specification ESR-M13P4-A:

- is used to keep the door and the window weatherstrip pliable and soft.
- should be applied to the weatherstrip at every lubrication period.
- makes the door easier to close.
- retards weatherstrip squeaks.
- retards weatherstrip wear.
- helps retain door window alignment by reducing friction between the glass frame and the rubber weatherstrip.
- should not be used prior to painting.

Body System

Inspection and Verification

Leaks

NOTE: Trim will reveal the location of most leaks.

1. Remove any trim or carpet in the general area of the leak.
2. Road test or water test the vehicle.
3. Inspect for a dust pattern around the area in question. Inspect for water paths near and above the area in question.
4. Some leaks can be located by placing bright light under the vehicle, removing any necessary trim or carpet, and inspecting the interior of the body at joints and weld lines.

Noise

Wind noise, rattles and their sources are detected by driving the vehicle at highway speeds. The vehicle should be driven in four different directions with all of the windows closed, the radio off, the blower motor off, and all of the ventilation ducts open.

Most wind noise leaks will occur at the door and window seals or at the sheet metal joints in the door or the door opening.

Symptom Chart

Symptom Chart

General Specifications

Item	Specification
RH wiper blade adjustment tolerance	12 mm (.47 in)
LH wiper blade adjustment tolerance	10 mm (.39 in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Radiator grille opening panel to front fender bolts	11	8	
Radiator grille opening panel bolts	11	8	
Pivot arm nuts	25	18	
Front fender bolts	9		80
Hood assist strut ball stud	16	12	
Speed control module to front fender bolts	10	7	

Front End Body Panels

The grille opening reinforcement:

- is bolted to the fenders and bumper beam.
- retains the headlamp assemblies and bumper cover.

The cowl vent screen is a two-piece component. The right side of the cowl vent screen may be removed without the removal of the windshield wiper pivot arm.

Cowl Vent Screen

Removal

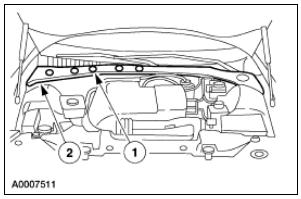
NOTE: To remove the left side cowl vent screen, the right cowl vent screen must be removed first. Follow the entire cowl vent screen procedure.

Right Side Only

1. **NOTE:** The fasteners are reuseable.

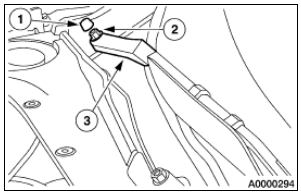
   Remove the right side of the cowl vent screen.

   1. Remove the two-part pin-type retainers and separate the Velcro ® attachment of the rubber hinge cover to the rear outboard corner of the cowl vent screen.
   2. Pull up on the cowl vent screen to release the lower clips.



Entire Cowl Vent Screen

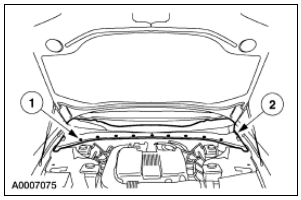
2. Remove the two wiper pivot arms.
   1. Remove the two pivot arm nut covers.
   2. Remove the two nuts.
   3. Remove the two wiper pivot arms.



3. **NOTE:** Remove the right side first when removing the entire cowl vent screen.

   Remove the cowl vent screen.

   1. Remove the two-part pin-type retainers and separate the Velcro® attachment of the rubber hinge cover to the rear outboard corner of the cowl vent screen.
   2. Lift up on the cowl vent screen to release the clips.

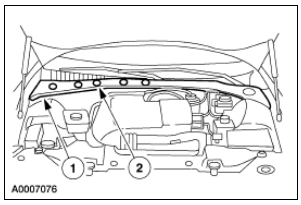


Installation

NOTE: When installing the entire cowl vent screen, install the left side first. Follow the entire cowl vent screen procedure.

Right Side Only

1. Install the right side of the cowl vent screen.
    1. Position the cowl vent screen and the Velcro® attachment of the rubber hinge cover.
    2. Install the two-part pin-type retainers.

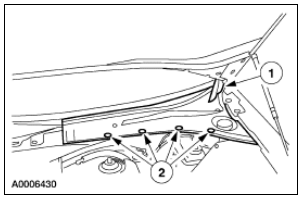


Entire Cowl Vent Screen

2. **NOTE:** Use the lower rearward clips as locators prior to installation, working from the center of the vehicle outward.

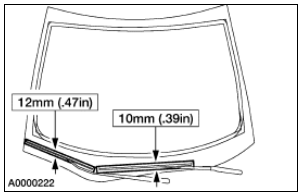
   Install the cowl vent screen.

    1. Position the windshield moulding flap over the left side cowl vent screen and attach the rubber hinge cover to the cowl screen.
    2. Install the cowl vent screens and install the two-part pin-type retainers.

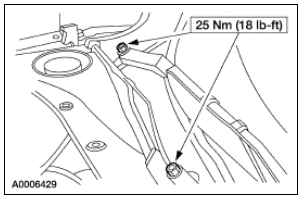


3. Cycle the windshield wiper motor to park the windshield wiper pivot arm shafts.

4. Install the windshield wiper and pivot arms onto the pivot shaft and align the blade to the heated wiper park/windshield wire lines on the windshield glass within the specification.



5. Tighten the windshield wiper pivot arm nuts.
    - Install the two pivot arm nut covers.



Fender

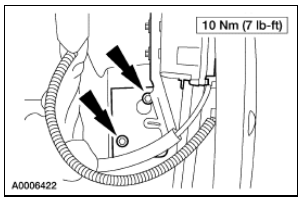
Removal and Installation

LH or RH Side

1. Remove the front bumper cover. For additional information, refer to Section 501-19 .
2. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
3. Remove the front and rear inner splash shield.

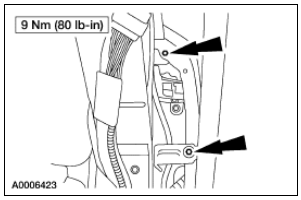
LH Side Only

4. Position the speed control module aside.
   - Loosen the top bolt.
   - Remove the bottom bolt.

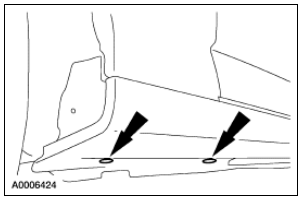


LH or RH Side

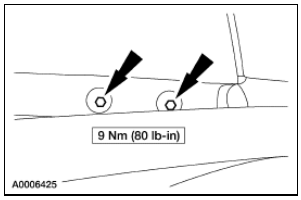
5. Remove the fender stuffer.
6. Remove the inner front fender bolts.



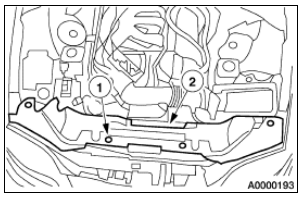
7. Remove the two front two-part pin-type retainers and position the front rocker moulding aside.



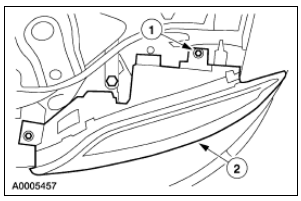
8. Remove the lower front fender bolts.



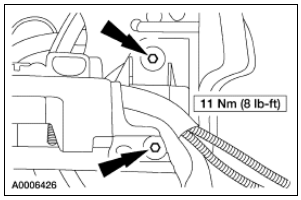
9. Remove the radiator upper sight shield.
    1. Remove the retainers.
    2. Remove the radiator upper sight shield.



10. Remove the headlamp assembly.
    1. Remove the three bolts.
    2. Remove the headlamp assembly.
    - Disconnect the electrical connector.



11. Remove the radiator grille opening panel to front fender bolts.

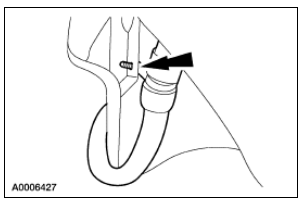


LH Side Only

12. Position the splash shield aside.

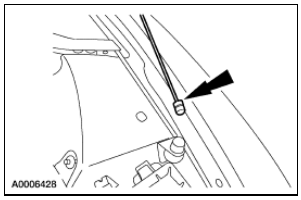
LH or RH Side

13. Disengage the wiring harness locator.

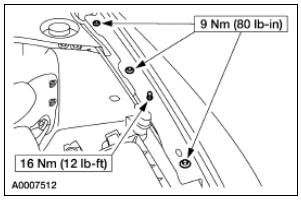


14. **NOTE:** Support the hood using a prop rod.

    Disengage the lower hood assist strut.



15. Remove the front fender bolts and the hood assist strut ball stud.



16. Remove the front fender.

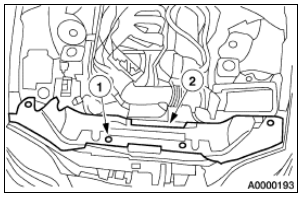
17. To install, reverse the removal procedure.

Radiator Grille Opening Panel

Removal and Installation

1. Remove the front bumper cover. For additional information, refer to Section 501-19 .

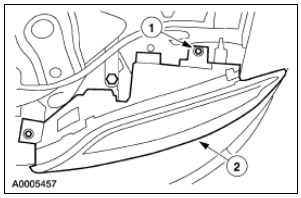
2. Remove the radiator upper sight shield.
    1. Remove the retainers.
    2. Remove the radiator upper sight shield.



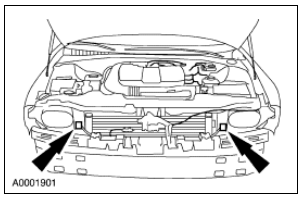
3. **NOTE:** LH side shown, RH side similar.

   Remove the two headlamp assemblies.

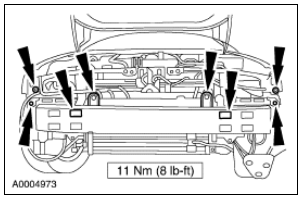
    1. Remove the six bolts.
    2. Remove the headlamp assemblies.
    - Disconnect the electrical connector.



4. Release the wiring harness fasteners and position the wiring harnesses rearward.



5. Remove the radiator grille opening panel bolts and the brackets.



6. Remove the radiator grille opening panel.

7. To install, reverse the removal procedure.

General Specifications

Item	Specification
Premium Long Life Grease XG-1-C or XG-1-K	ESA-M1C75-B
Silicone Lubricant C0AZ-19553-A	ESR-M13P4-A
Silicone Lubricant (Spray) F5AZ-19533-AA	ESR-M13P4-A
Multi-Purpose Grease Spray F5AZ-19G209-AA	ESR-M1C159-A

Torque Specifications

Description	Nm	lb-ft
Door check strap nuts	12	9
Door check strap screws	12	9
Door latch striker bolts	40	30
Hinge to door bolts	30	22
Hinge to luggage compartment lid bolts	12	9
Inner front door support bracket nuts and bolt	12	9

Torsion Bar Loading

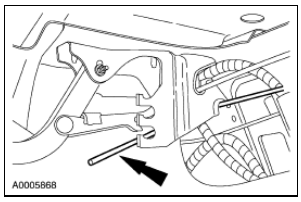
⚠ WARNING: Safety glasses must be worn when carrying out this operation. Failure to follow these instructions may result in physical injury.

1. **NOTE:** The luggage compartment lid tension should be decreased if the luggage compartment lid (40110) opens with more force than desired. The luggage compartment lid tension should be increased if the luggage compartment lid opens with less force than desired.

   Open and support the luggage compartment lid in the full-open position.

2. **⚠ WARNING: Use care when adjusting the luggage compartment lid torsion bar. It is under tension and could spring out of control if it is not handled correctly. Failure to follow these instructions could result in personal injury.**

   Move the luggage compartment lid end of the luggage compartment lid torsion bar to another position.



3. Check the adjustment.

4. If required, move the luggage compartment lid end of the luggage compartment lid torsion bar to another position.

Door

Removal

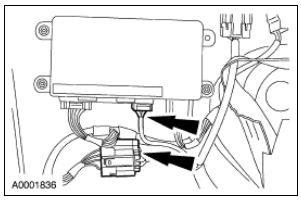
All Doors

1. Remove the door trim panel. For additional information, refer to Section 501-05 .
2. Remove the screws and the speaker.

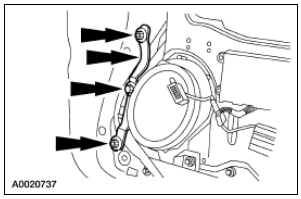
Front Door

3. **NOTE:** Driver door shown, passenger door similar.

   Disconnect the electrical connectors.



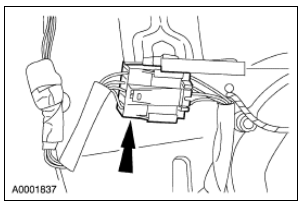
4. Remove the two nuts, the bolt and the inner front door support bracket.



5. Release the wiring harness locators.

Rear Door

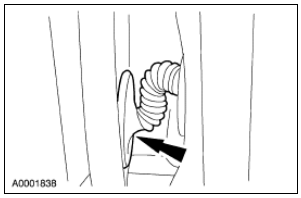
6. Disconnect the electrical connector.



7. Release the wiring harness locators.

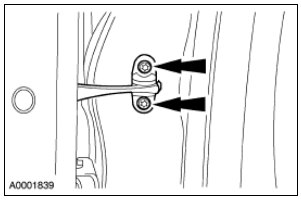
All Doors

8. Remove the grommet and wiring harness.



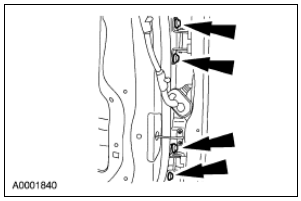
9. ⚠ **CAUTION: Do not close the door after the door check screws have been removed.**

   Remove the door check strap screws.



10. Mark the hinge location on the door.
11. **NOTE:** An assistant is required to support the door during its removal.

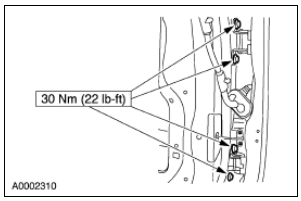
    Remove the hinge to door bolts and the door.



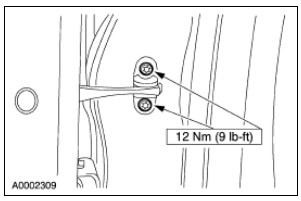
Installation

All Doors

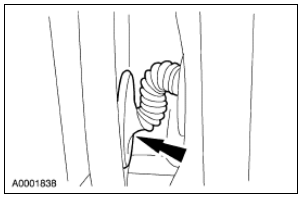
1. Position the door and install the hinge to door bolts.



2. Install the door check strap screws.

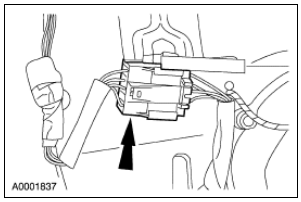


3. Install the grommet and the wiring harness.



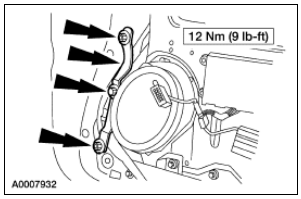
Rear Door

4. Connect the electrical connector.

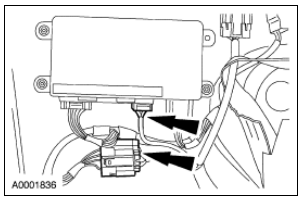


Front Door

5. Install the front door support bracket, the two nuts and the bolt.



6. Connect the electrical connectors.



All Doors

7. Install the screws and the speaker.

8. Install the door trim panel. For additional information, refer to Section 501-05 .

9. Check the door for a flush fit to the body.

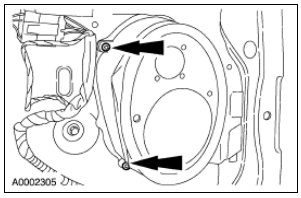
Door Check Strap

Removal and Installation

All Doors

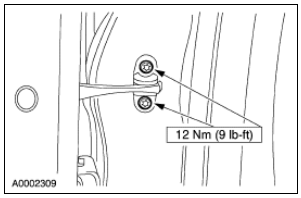
1. Remove the door trim panel. For additional information, refer to Section 501-05 .

2. Remove the screws and the speaker.



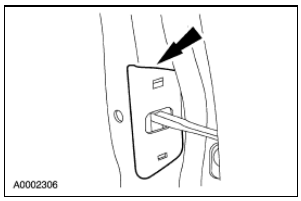
3. ⚠ **CAUTION: Do not close the door after removal of the check strap screws**

   Remove the door check strap screws.



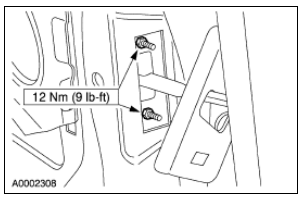
Rear Door

4. Remove the cover.



All Doors

5. Remove the nuts and the door check strap.



6. To install, reverse the removal procedure.

General Specifications

Item	Specification
Adhesives	
Headliner Adhesive F1VY-19562-A	WSS-M2G355-B

Torque Specifications

Description	Nm	lb-ft
Front seat safety belt nut	40	30
Rear safety belt anchor bolt	40	30

Interior Trim

The interior trim consists of:

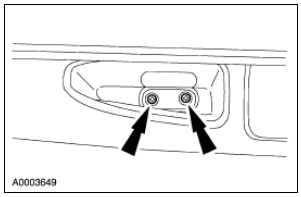
- door trim panels
- headliner (coupe)
- package tray trim panel (coupe)
- rear quarter trim panels
- sun visors
- tether anchor covers (coupe)
- upper quarter trim panel (coupe)
- scuff plates
- lower A-pillar trim panels
- windshield side garnish mouldings

Trim Panel Front Door

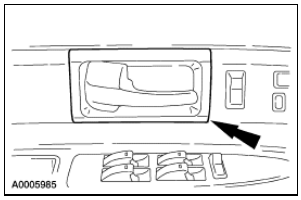
Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

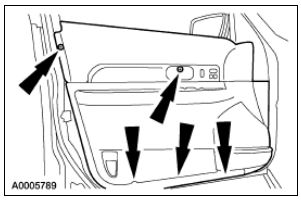
2. Lift the cover and remove the screws.



3. Remove the interior door handle trim panel.



4. Remove the five screws and remove the trim panel.
   - Disconnect the electrical connectors.



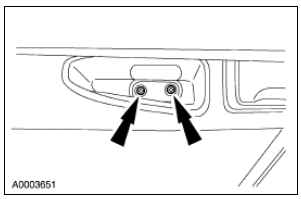
Installation

1. To install, reverse the removal procedure.

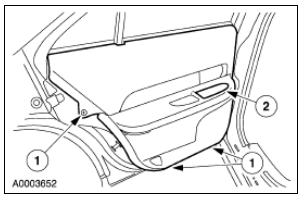
Trim Panel Rear Door

Removal

1. Lift the cover and remove the screws.



2. Remove the door trim panel.
    1. Remove the three screws.
    2. Remove the ashtray assembly.
    - Disconnect the electrical connectors.



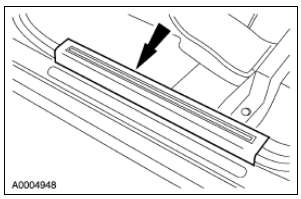
Installation

1. To install, reverse the removal procedure.

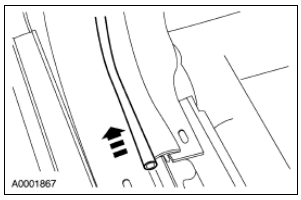
Trim Panel A-Pillar Lower

Removal

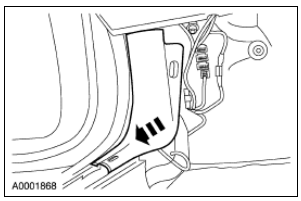
1. Remove the front scuff plate.



2. Pull back the weatherstrip.



3. Remove the A-pillar lower trim panel.



Installation

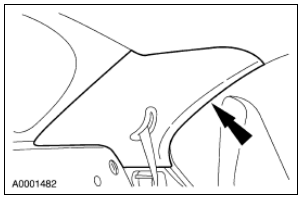
1. To install, reverse the removal procedure.

Trim Panel Package Tray

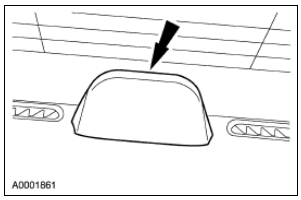
Removal

1. Remove the rear seat bolsters. For additional information, refer to Section 501-10 .

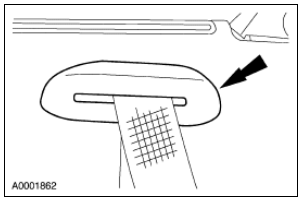
2. Position the two quarter trim panels aside.



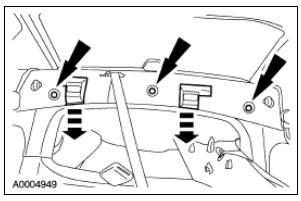
3. Remove the rear high mounted stoplamp (HMSL) cover.



4. Remove the rear center safety belt cover.



5. Remove the pin-type retainers and pull down the rear seat latch covers.



6. Remove the package tray trim panel.

Installation

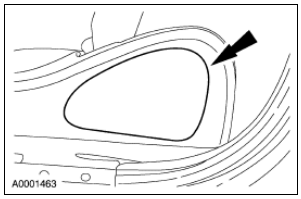
1. To install, reverse the removal procedure.

Trim Panel Upper B-Pillar

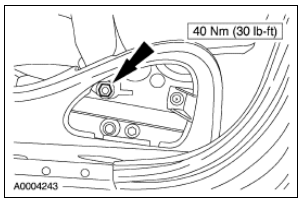
Removal

1. Pull back the weatherstrip surrounding the upper B-pillar trim.

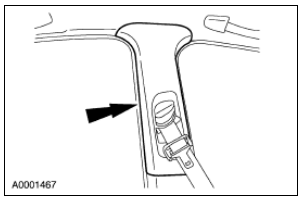
2. Remove the front seat safety belt cover.



3. Remove the front seat safety belt nut.



4. Remove the upper B-pillar trim.



Installation

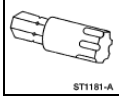
1. **NOTE:** Position the shoulder safety belt height adjuster at its highest setting before installing the B-pillar trim.

   To install, reverse the removal procedure.

   - Check the restraint system for correct operation.

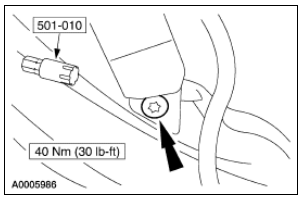
Trim Panel Quarter

Special Tool(s)

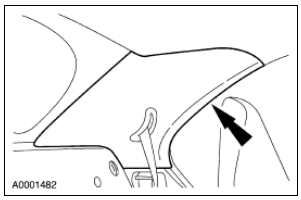
 ST1181-A	Safety Belt Bolt Bit 501-010 (T77L-2100-A)

Removal

1. Remove the rear seat bolster. For additional information, refer to Section 501-10 .
2. Using the special tool, remove the rear safety belt anchor bolt.



3. Remove the quarter trim panel.



Installation

1. **NOTE:** Position the weatherstrip over the quarter trim panel.

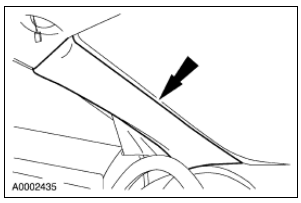
   To install, reverse the removal procedure.

   - Check the restraint system for correct operation.

Trim Panel Windshield Side Garnish Moulding

1. Position the weatherstrip aside.

2. Remove the windshield side garnish moulding.



Installation

1. To install, reverse the removal procedure.

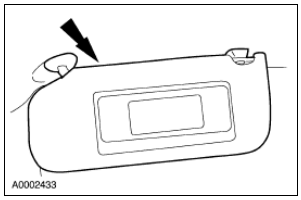
Headliner

Removal

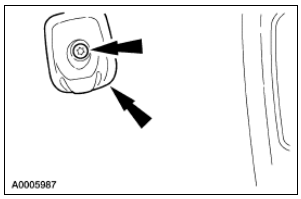
1. Move the front passenger seat fully rearward and fully recline.

2. Move the driver seat fully forward and the seat backrest fully upright.

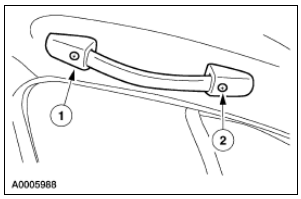
3. Remove the screws and the sun visors.
   - Disconnect the electrical connectors.



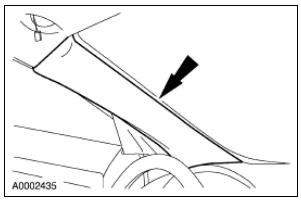
4. Remove the screws and the sun visor clips.



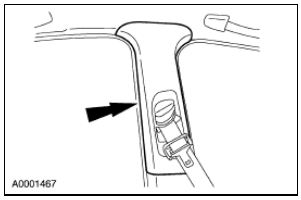
5. Remove the four assist handles.
   1. Position the end caps aside.
   2. Remove the screws.



6. Remove the windshield side garnish mouldings.

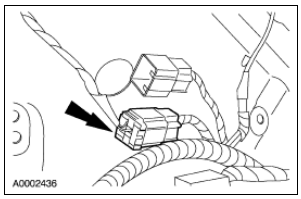


7. Position the upper B-pillar trim aside.



8. Position the upper portion of the door weatherstrip seals aside.
9. Remove the quarter trim panels. For additional information, refer to Trim Panel Quarter .
10. **NOTE:** Vehicles without moon roofs Use a plastic scraper to detach the headliner from the roof.

    Release the map lamp clips and lower the headliner.
11. Disconnect the electrical connector.



12. Remove the headliner from the left rear door opening.

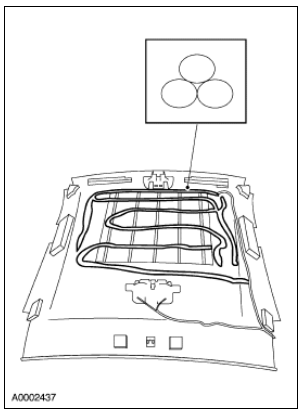
Installation

Installing New Headliner

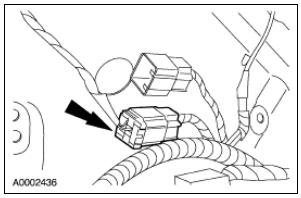
1. ⚠ **CAUTION: Folding the headliner will result in damage to the headliner.**

   Carefully position the headliner in the vehicle.
2. **NOTE:** Adhesive required for vehicles without moon roofs.

   Apply Headliner Adhesive F1VY-19562-A or equivalent meeting Ford specification WSS-M2G355-B in a triangular pattern to the center of the headliner.



3. Connect the electrical connector.



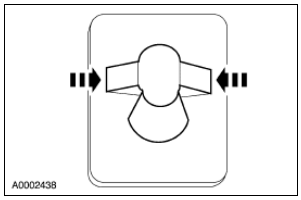
4. Press the headliner against the roof to make sure adhesive contacts both surfaces.

Installing Existing Headliner

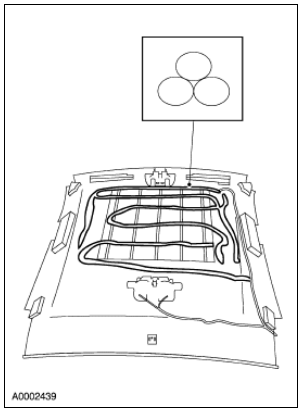
5. ⚠ **CAUTION: Folding the headliner will result in damage to the headliner.**

   Carefully position the roof headliner in the vehicle.

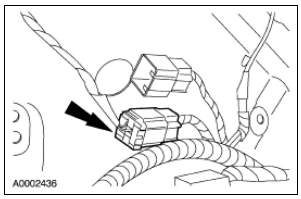
6. Bend the tabs of the rear locator back into their original position.



7. Apply Headliner Adhesive F1VY-19562-A or equivalent meeting Ford specification WSS-M2G355-B in a triangular pattern to the center of the headliner.



8. Connect the electrical connector.

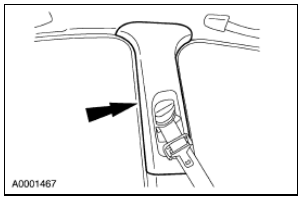


9. Press the headliner against the roof to make sure the adhesive contacts both surfaces.

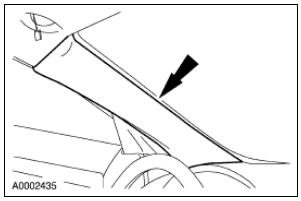
New or Existing Headliner

10. Install the quarter trim panels. For additional information, refer to Trim Panel Quarter .

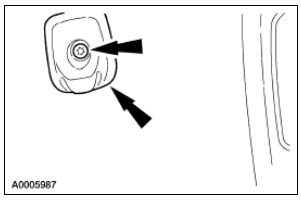
11. Install the upper B-pillar trim.



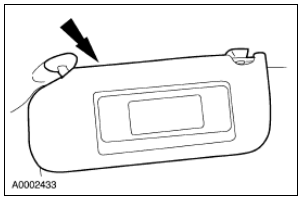
12. Install the windshield garnish mouldings on each side.



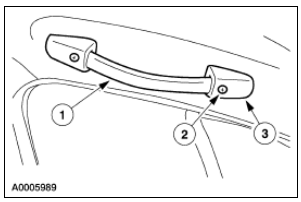
13. Position the sun visor clips and install the screws.



14. Connect the electrical connectors, position the sun visors, and install the screws.



15. Install the four assist handles.
    1. Position the assist handles.
    2. Install the screws.
    3. Install the end caps.



16. Install the door weatherstrips.

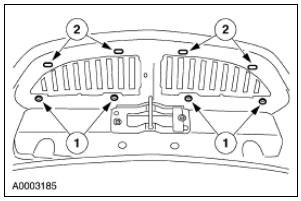
17. Place the seats in upright positions.

Radiator Grille

Removal and Installation

1. Open the hood.

2. Remove the radiator grille.
    1. Remove the nuts.
    2. Release the clips.

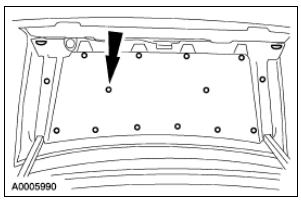


3. To install, reverse the removal procedure.

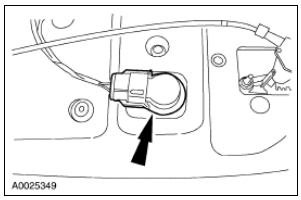
License Plate Housing

Removal and Installation

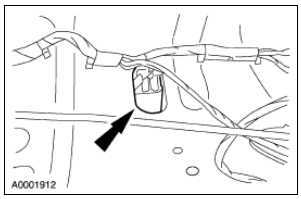
1. Remove the pin-type retainers and the luggage compartment lid trim panel.



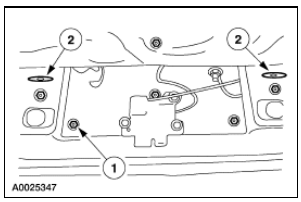
2. Disconnect the two reversing lamp electrical connectors.



3. Disconnect the two license plate lamp electrical connectors.



4. Remove the license plate housing.
    1. Remove the nuts.
    2. Release the retaining clips.



5. To install, reverse the removal procedure.
    - Transfer components as necessary.

Torque Specifications

Description	Nm	lb-ft	lb-in
Exterior rear view mirror nuts	5		44
Mirror motor screws	2		18

Rear View Mirrors

Rear View Mirrors

The exterior rear view mirror is:

- electrically operated.
- controlled by the exterior mirror control switch for both vertical and horizontal movement.

The interior rear view mirror features automatic dimming which:

- automatically reduces glare caused by headlamps reflecting in the interior rear view mirror.
- houses two sensors to determine dimmer actuator.
- activates whenever the ignition is in the RUN or ACC position.
- defaults to the NORMAL setting when the transmission is shifted to REVERSE to allow a bright view for backing up.
- is disabled by pushing the mirror-mounted switch to the OFF position.
- can be manually activated or deactivated.

Memory

The memory mirror:

- automatically provides preferred positioning of the exterior rear view mirrors.
- may be recalled through the door-mounted switches, the remote-entry transmitter or keyless entry keypad.
- provides recall when the ignition switch is in the OFF or RUN position and the transmission is in the PARK or NEUTRAL position.
- position is stored in the driver door module (DDM).

Heated Mirrors

The heated mirror function:

- provides electric heating to both the driver and passenger side exterior rear view mirrors.
- raises the temperature of the glass to clear frost and condensation.
- is activated by activating the rear defrost button.
- automatically shuts off after ten minutes.

Electrochromic Interior Rear View Mirror

The optional electrochromic interior rear view mirror:

- is equipped with an automatic dimming feature that controls the interior rear view mirror reflecting surface to reduce glare caused by headlamps reflecting in the mirror.
- has two integral sensors to control dimming functions.
- defaults to normal setting when the transmission is shifted to REVERSE to allow a bright view for backing up.
- can be switched off by pressing the MODE switch to the OFF position.

Rear View Mirrors

Refer to Wiring Diagrams Cell 125 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool
 ST1137-A	73 III Automotive Meter 105-R0057 or equivalent

Principles of Operation

Exterior Mirrors

The exterior mirrors are controlled by the exterior rear view mirror control. The exterior rear view mirror control is hardwired to the driver door module (DDM). When the driver exterior rear view mirror is selected, adjustment is carried out by moving the control to the desired position. The DDM receives the adjustment input command from the exterior rear view mirror control and supplies power and ground to the appropriate exterior rear view mirror motor to adjust the exterior rear view mirror. The passenger exterior rear view mirror is controlled by the front electronics module (FEM). When the DDM receives an adjustment command for the passenger exterior rear view mirror, the DDM interprets the command and sends the adjustment command over the SCP communication network to the FEM. The FEM interprets the command and supplies power and ground to the appropriate exterior rear view mirror motor to adjust the exterior rear view mirror.

Memory Operation

The DDM and FEM constantly track mirror position. Each exterior mirror motor is equipped with a potentiometer, which the modules monitor to track the mirror position. This position remains in memory as long as the module retains power. When a position is stored in memory by the operator, the module will retain this position in memory for future recall. When a memory position is recalled by the operator, the DDM and FEM will power the exterior mirror motors simultaneously and monitor the potentiometer circuits. When the stored memory position is reached, the DDM and FEM will remove power from the motors. If the exterior rear view mirror control is operated during a memory recall, the modules will stop the memory recall and respond to the exterior rear view mirror control command.

Heated Exterior Mirrors

The heated exterior mirrors will only function when the rear window defrost is operating. There is no separate control for heated exterior mirrors, they will function anytime the rear window defrost is ON. For additional information on the rear window defrost, refer to Section 501-11 .

The heated mirror power is supplied by the rear window defrost relay through a separate battery junction box (BJB) fuse that isolates the heated mirrors from the rear window defrost in the event of a concern.

Electrochromic Interior Rear View Mirror

The electrochromic interior rear view mirror will lighten or darken depending on the input of the sensors that are internal to the mirror.

The electrochromic interior rear view mirror reverse input is supplied by a hardwired circuit to the rear electronic module (REM). When REVERSE is selected, the REM will receive the PRNDL message over the SCP communication network from the PCM stating reverse has been selected. The REM will then supply a power signal to the electrochromic interior rear view mirror causing the electrochromic interior rear view mirror to cancel any dimming function currently operating and return to a full bright status. When the gear selector is moved out of REVERSE, the electrochromic interior rear view mirror returns normal operation and resumes any interrupted dimming functions.

If the REM does not receive the PRNDL information from the PCM, a communication DTC will be logged. As a default, the REM will supply power to the dimming circuit preventing the automatic dimming function from operating until the message and communication is restored.

The reverse message supplied to the REM has a time delay before the message is sent by the PCM. This delay allows for the gear selector to be moved through REVERSE without canceling dimming operations.

When installing a new electrochromatic interior rear view mirror, it is necessary to set the compass zone and calibrate the compass, refer to Section 419-11 .

Switched System Power (SSP)

The SSP is invoked by both the FEM and REM. This function removes power from relays that provide power to the exterior lamps, interior lamps, and power door locks. This is only accomplished when both the FEM and the REM are in sleep mode. The sleep function of the FEM and REM places the modules in sleep mode when the ignition switch is in the OFF position, and no wake up (inputs) signals occur for 30 minutes. The module will not sleep if the parking lamps or the hazard lamps are active. The following relays are controlled by the SSP function: SSP1, SSP2, SSP3, and SSP4. When either the FEM or REM are not in sleep mode, all SSP relays will be energized. Each relay, when energized, will supply power to multiple features/functions. For additional information, refer to the SSP Relay Index for diagnosis and testing of SSP-related issues.

Inspection and Verification

1. Verify the customer concern by operating the system.

2. Visually inspect for obvious signs of mechanical or electrical damage.

   Visual Inspection Chart

Mechanical	Electrical
• Damaged exterior rear view mirrors • Damaged interior rear view mirror	• Battery junction box (BJB) Fuses 406 (10A), 409 (5A), 422 (20A), 423 (30A), 424 (30A), 425 (40A), 427 (30A), and 432 (30A). • Central junction box (CJB) Fuse 207 (5A), 216 (5A), 222 (10A), and 235 (5A). • Switched system power (SSP) relays 1 and 2. • Exterior rear view mirror control. • Exterior rear view mirror motor. • Exterior rear view mirror glass. • Electrochromic interior rear view mirror. • Wiring harness.

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. If the diagnostic tool tester does not power up, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTICS. If the diagnostic tool responds with:
   - CKT 914, CKT 915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for FEM, Go To Pinpoint Test A .
   - NO RESP/NOT EQUIP for REM, Go To Pinpoint Test B .
   - NO RESP/NOT EQUIP for DDM, Go To Pinpoint Test C .
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the FEM, REM and DDM.

6. If the DTCs retrieved are related to the concern, go to the FEM Diagnostic Trouble Code (DTC) Index, REM Diagnostic Trouble Code (DTC) Index, or DDM Diagnostic Trouble Code (DTC) Index.

7. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue the diagnostics.

FEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1319	Driver Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1327	Passenger Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1342	ECU Is Defective	FEM	CLEAR the DTC. REPEAT the FEM self-test. If DTC B1342 is retrieved, INSTALL a new FEM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test.
B1438	Wiper Mode Select Switch Circuit Failure	FEM	REFER to Section 501-16 .
B1446	Wiper Park Sense Circuit Failure	FEM	REFER to Section 501-16 .
B1479	Wiper Washer Fluid Level Sensor Circuit Failure	FEM	REFER to Section 413-01 .
B1499	Lamp Turn Signal Left Circuit Failure	FEM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1503	Lamp Turn Signal Right Circuit Failure	FEM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1519	Hood Switch Circuit Failure	FEM	REFER to Section 419-01A .
B1567	Lamp Headlamp High-Beam Circuit Failure	FEM	REFER to Section 417-01 .
B1676		FEM	REFER to Section 414-00 .

	Battery Pack Voltage Out of Range		
B1794	Lamp Headlamp Low-Beam Circuit Failure	FEM	REFER to Section 417-01 .
B2214	Window Passenger Front Up Switch Short to Battery	FEM	REFER to Section 501-11 .
B2215	Window Passenger Front Down Switch Short to Battery	FEM	REFER to Section 501-11 .
B2312	Mirror Passenger Horizontal Feedback Potentiometer Circuit Failure	FEM	Go To Pinpoint Test E .
B2316	Mirror Passenger Vertical Feedback Potentiometer Circuit Failure	FEM	Go To Pinpoint Test E .
B2477	Module Configuration Failure	FEM	REFER to Section 418-01 .
C1284	Oil Pressure Switch Failure	FEM	REFER to Section 413-01 .
C1446	Brake Switch Circuit Failure	FEM	REFER to Section 413-01 .
C1924	VAPS Solenoid Actuator Output Circuit Short to Ground	FEM	REFER to Section 211-00 .
C1925	VAPS Solenoid Actuator Return Circuit Failure	FEM	REFER to Section 211-00 .
U1027	SCP (J1850) Invalid or Missing Data for Engine RPM	PCM	CARRY OUT the PCM self-test.
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission / Transaxle / PRNDL	PCM	CARRY OUT the PCM self-test.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the ICM self-test.
U1222	SCP (J1850) Invalid or Missing Data for Interior Lamps	ICM	CARRY OUT the ICM self-test.
U1227	SCP (J1850) Invalid or Missing Data for Body Status Request	ICM	CARRY OUT the ICM self-test.

REM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1201	Fuel Sender Circuit Failure	REM	REFER to Section 413-01 .
B1300	Power Door Lock Circuit Failure	REM	REFER to Section 501-14B .
B1310	Power Door Unlock Circuit Failure	REM	REFER to Section 501-14B .
B1331	Decklid Ajar Rear Door Circuit Failure	REM	REFER to Section 417-02 .
B1335	Door Ajar RR Circuit Failure	REM	REFER to Section 417-02 .
B1342	ECU Is Defective	REM	CLEAR the DTC. REPEAT the REM self-test. If DTC B1342 is retrieved, INSTALL a new REM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the

			self-test.
B1483	Brake Pedal Input Circuit Failure	REM	REFER to Section 417-01 .
B1499	Lamp Turn Signal Left Circuit Failure	REM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	REM	REFER to Section 417-01 .
B1503	Lamp Turn Signal Right Circuit Failure	REM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	REM	REFER to Section 417-01 .
B1551	Decklid Release Circuit Failure	REM	REFER to Section 501-14B .
B1571	Door Ajar LR Circuit Failure	REM	REFER to Section 417-02 .
B1676	Battery Pack Voltage Out of Range	REM	REFER to Section 414-00 .
B2172	Inertia Switch input Circuit Open	REM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
B2174	Window Driver Rear Remote Up Switch Short to Battery	REM	REFER to Section 501-11 .
B2178	Window Driver Rear Remote Down Switch Short to Battery	REM	REFER to Section 501-11 .
B2190	Window Passenger Rear Remote Up Switch Short to Battery	REM	REFER to Section 501-11 .
B2194	Window Passenger Rear Remote Down Switch Short to Battery	REM	REFER to Section 501-11 .
B2477	Module Configuration Failure	REM	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/ PRNDL	PCM	CARRY OUT the PCM self-test.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the ICM self-test

DDM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1309	Power Door Lock Circuit Short to Ground	DDM	REFER to Section 501-14B .
B1341	Power Door Unlock Circuit Short to Ground	DDM	REFER to Section 501-14B .
B1342	ECU Is Defective	DDM	CLEAR the DTC. REPEAT the DDM self-test. If DTC B1342 is retrieved, INSTALL a new DDM. REFER to Section 419-10 .CLEAR the DTCs. REPEAT the self-test.
B1400	Driver Power Window One Touch Window Relay Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1405	Driver Power Window Down Circuit Short to Battery	DDM	REFER to Section 501-11 .

B1408	Driver Power Window Up Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1416	Power Window LR Motor Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1420	Passenger Power Window Motor Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1424	Power Window RR Motor Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1530	Memory Set Switch Circuit Short to Ground	DDM	Go To Pinpoint Test G .
B1534	Memory 1 Switch Circuit Short to Ground	DDM	Go To Pinpoint Test G .
B1538	Memory 2 Switch Circuit Short to Ground	DDM	Go To Pinpoint Test G .
B1676	Battery Pack Voltage Out of Range	DDM	REFER to Section 414-00 .
B2112	Door Driver Set Switch Stuck Failure	DDM	REFER to Section 501-14B .
B2116	Door Driver Reset Switch Stuck Failure	DDM	REFER to Section 501-14B .
B2320	Mirror Driver Horizontal Feedback Potentiometer Circuit Failure	DDM	Go To Pinpoint Test E .
B2324	Mirror Driver Vertical Feedback Potentiometer Circuit Failure	DDM	Go To Pinpoint Test E .
B2336	Mirror Switch Assembly Circuit Failure	DDM	Go To Pinpoint Test E .
B2425	Remote Keyless Entry Out of Synchronization	DDM	REFER to Section 501-14B .
B2477	Module Configuration Failure	DDM	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test. REFER to Section 206-09A .
U1059	SCP (J1850) Invalid or Missing Data for Transmission / Transaxle / PRNDL	PCM	CARRY OUT the PCM self-test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

SSP Relay Index [a]

Relay	Fuse	Controlled System(s)
SSP1	BJB Fuse 427 (30A)	• Driver power door lock (FEM) • LH high beam headlamps (FEM) • RF park/turn/side marker lamps (FEM) • RH low beam headlamp • Driver exterior rear view mirror • LF park/turn/side marker lamps (FEM)
SSP2	BJB Fuse 432 (30A)	

		• LH low beam headlamp (FEM) • RH high beam headlamps (FEM) • Passenger exterior rear view mirror (FEM) • Switch illumination backlighting
SSP3	BJB Fuse 424 (30A)	• High mounted stoplamp (REM) • RR park/stoplamps (REM) • Reversing lamps (REM) • LR turn signals (REM) • Interior courtesy and demand lighting (FEM)
SSP4	BJB Fuse 423 (30A)	• LR park/stoplamps (REM) • RR turn signals (REM) • All passenger door locks (REM) • License lamps • Luggage compartment release solenoid/switch • Fuel door release solenoid/switch • Luggage compartment lamp

[a] When diagnosing an SSP relay, check that all systems for that relay are inoperative. REFER to Section 417-01

Symptom Chart

Refer to the Wiring Diagrams for connector numbers stated in the Pinpoint Tests.

Symptom Chart

Pinpoint Tests

⚠ CAUTION: Electronic modules are sensitive to electrical charges. If exposed to these charges, damage may result.

PINPOINT TEST A: NO COMMUNICATION WITH THE FRONT ELECTRONIC MODULE (FEM)

PINPOINT TEST B: NO COMMUNICATION WITH THE REAR ELECTRONIC MODULE (REM)

PINPOINT TEST C: NO COMMUNICATION WITH THE DRIVER DOOR MODULE (DDM)

PINPOINT TEST D: THE MIRRORS ARE INOPERATIVE

PINPOINT TEST E: A SINGLE MIRROR IS INOPERATIVE

PINPOINT TEST F: THE AUTO DIMMING MIRROR DOES NOT OPERATE CORRECTLY

PINPOINT TEST G: THE MEMORY MIRROR IS INOPERATIVE

PINPOINT TEST H: THE MEMORY MIRROR IS INOPERATIVE MEMORY SET SWITCH LED

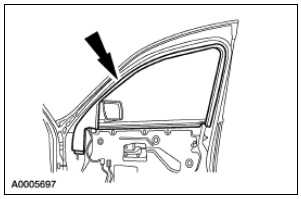
PINPOINT TEST I: THE HEATED EXTERIOR MIRROR DOES NOT DEFROST

Mirror Exterior Rear View

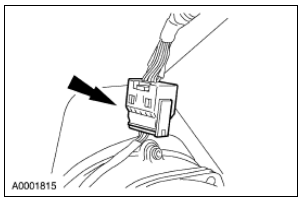
Removal and Installation

1. Remove the front door trim panel. For additional information, refer to Section 501-05 .

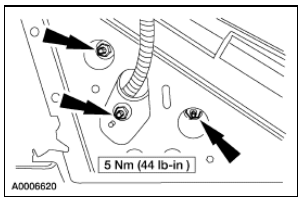
2. Remove the interior garnish moulding.



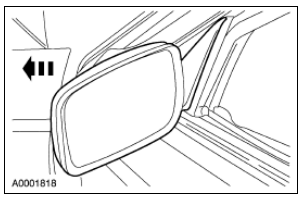
3. Disconnect the electrical connector.



4. Remove the exterior rear view mirror nuts.



5. Remove the exterior rear view mirror.

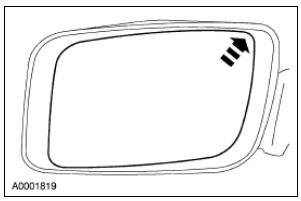


6. To install, reverse the removal procedure.

Mirror Glass

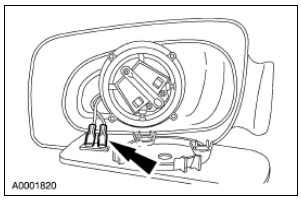
Removal and Installation

1. Push in the upper edge of the mirror glass to the maximum travel.



2. Grasp the bottom of the mirror glass and pull outward.

3. Disconnect the electrical connectors and remove the mirror glass.



4. **NOTE:** When installing the mirror glass, make sure it snaps into the mirror motor.

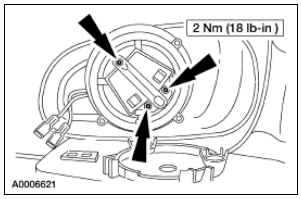
   To install, reverse the removal procedure.

Mirror Motor

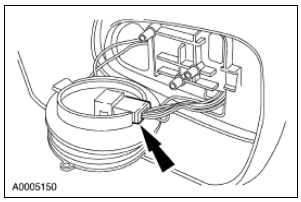
Removal and Installation

1. Remove the exterior rear view mirror glass. For additional information, refer to Mirror Glass .

2. Remove the mirror motor screws.



3. Disconnect the electrical connector and remove the mirror motor.



4. To install, reverse the removal procedure.

Mirror Interior Rear View

Special Tool(s)

 ST1793-A	Rear View Mirror Replacer 501-025 (T94P-17700-AH)

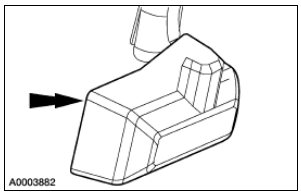
Removal

⚠ CAUTION: The interior rear view mirror is a breakaway design. Excessive force in any direction will cause damage to the interior rear view mirror.

Equipped With Rain-Sensitive Wipers

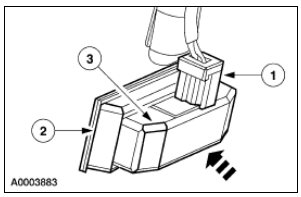
1. **NOTE:** To avoid damage to the rain sensor module cover, push up on the cover while rotating the top of the cover toward the rear of the vehicle.

   Remove the rain sensor module cover.



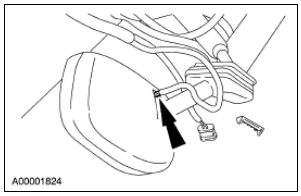
2. Remove the rain sensor module.
   1. Pull the latch on the connector away from the harness and disconnect the electrical connector.
   2. **NOTE:** When removing the rain sensor module, it is necessary to apply inward pressure on the module prior to releasing the rain sensor module retaining slides.

      Release the rain sensor module retaining slides.
   3. Remove the rain sensor module.

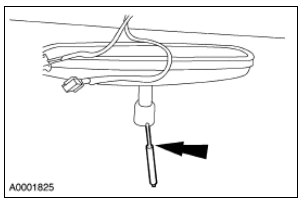


All Vehicles

3. Disconnect the electrical connector.



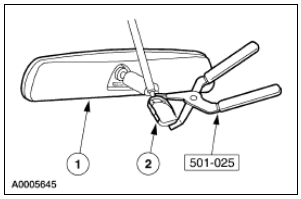
4. Insert a small, flathead screwdriver into the mirror base and remove the rear view mirror.



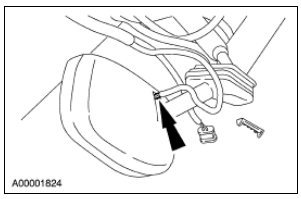
Installation

All Vehicles

1. Install the interior rear view mirror.
    1. Slide the interior rear view mirror onto the bracket.
    2. Using the special tool, connect the rear view mirror to the windshield bracket.



2. Connect the electrical connector.



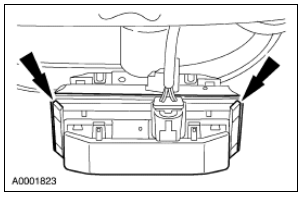
Equipped With Rain-Sensitive Wipers

3. **NOTE:** Prior to installing the rain sensor module, the windshield glass area between the rain sensor module brackets must be cleaned.

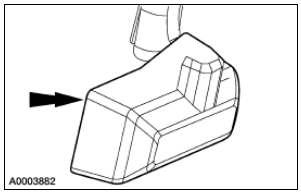
   NOTE: When installing the rain sensor module, it is necessary to apply inward pressure on the module prior to locking the rain sensor module retaining slides in place.

   Install the rain sensor module.

   - Connect the electrical connector.



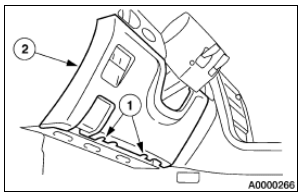
4. Install the rain sensor module cover.


A0003882

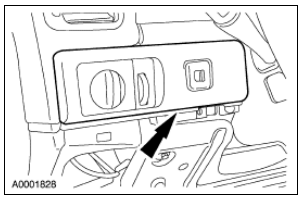
Switch Exterior Rear View Mirror Control

Removal and Installation

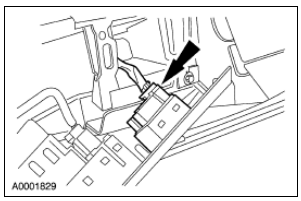
1. Remove the instrument panel steering column cover.
    1. Remove the screws.
    2. Remove the instrument panel steering column cover.
    - Disconnect the electrical connectors.



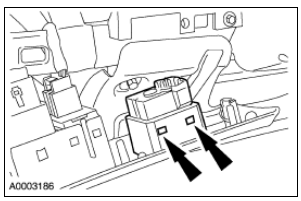
2. Remove the upper finish panel.



3. Disconnect the interior rear view mirror control switch electrical connector.



4. Remove the interior rear view mirror control switch.



5. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Rear seat bolster nut	11	8	
Front seat track to floor bolts	25	18	
Front seat track to floor nuts	25	18	
Front safety belt to nut	40	30	
Front seat backrest bolts	25	18	
Front seat safety belt buckle bolt	40	30	
Side air bag nuts	7		62
Rear seat backrest nuts	48	35	
Front seat track nuts	20	15	
Rear center safety belt anchor nut	48	35	

Seats

Seats Front

The front seats have the following features:

- memory set (optional)
- power lumbar (optional)
- manual lumbar
- horizontal, vertical and front and rear tilt adjustments
- power recline
- heat (optional)

Adjustment of the seat may be accomplished with the seat regulator control switch located on the side of the seat.

Seats Rear

The rear seat has the following features:

- fold down seat backrest
- removable cushion retained by two latches located at the front of the cushion
- two rear bolsters on each side of the rear seat backrest

Fold down the rear seat backrest by releasing the two levers in the luggage compartment.

Seats Power Recliner

The power recliner tilts the seat backrest rearward or forward and is controlled by the seat regulator control switch.

The power recliner cannot be repaired separately. If the power recliner needs to be repaired, an entirely new front seat backrest latch must be installed.

Seats Power Lumbar Support

The seat has electro-mechanical front seat backrest pad adjuster. The lumbar switch adjustment is on the side of the seat.

Seats Manual Lumbar Support

The manual front seat backrest lumbar is adjusted by a knob (57620) mounted on the front of the seat cushion.

Seats Memory Set

This system allows automatic positioning of the driver seat, outside rearview mirrors, and power adjusted tilt/telescope steering column to two programmable positions.

The memory seat control is located on the driver door.

Seats Heated

Each heated front seat is controlled by a switch on the instrument panel.

The heated seat system will only operate with the ignition switch in the RUN position.

Side Air Bag

Driver and passenger side air bags (611A08) are attached to the seat backrest frame. For diagnostic information or if the side air bag has been deployed, refer to Section 501-20B .

The front seat backrest trim covers cannot be repaired. If the front seat backrest covers need to be repaired, an entirely new cover must be installed. Cleaning the front seat backrest cover is permissible.

If a side air bag deployment took place, a new seat back pad, trim cover and side air bag module must be installed. Install a new seat backrest frame if necessary.

Seats Driver Seat Module

The driver seat module is attached to the driver seat track. For additional information, refer to Section 419-10 for removal and installation procedures.

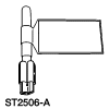
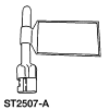
Seats

Refer to Wiring Diagrams Cell 119 , Climate Controlled Seats for schematic and connector information.

Refer to Wiring Diagrams Cell 120 , Power Seats for schematic and connector information.

Refer to Wiring Diagrams Cell 123 , Memory Seats for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation Star (NGS) Tester 418-F052 (007-00500) or equivalent scan tool
 ST2502-A	Diagnostic Tool, Restraint System (2 Required) 418-F395
 ST2506-A	Diagnostic Tool, Restraint System (2 Required) 418-F088
 ST2507-A	Diagnostic Tool, Restraint System (2 Required) 418-133

Restraint System Diagnostic Tool Warning

⚠ WARNING: The Restraint System Diagnostic Tools are for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

Principles of Operation

Driver Power Seat

The driver power seat is controlled by the driver seat module (DSM). The DSM does not need to be configured, however the drive seat does need to be calibrated when the DSM is installed. The driver seat regulator control switch provides voltage to the DSM when activated. The neutral position of each driver seat regulator control switch position is a ground state through the seat regulator control switch contacts. A voltage input causes the DSM to power the appropriate motor until the input is removed. Ground is the normal state of the motor circuits through the DSM and is not switched to control the motors. The DSM internally switches the appropriate line from ground to power to adjust the motors.

As the seat is adjusted, the DSM constantly monitors the motor position sensors to record the current seat position. The DSM will remove power from the motor upon termination of the seat regulator control switch input or if the DSM does not see movement from the motor by monitoring the position sensor. The DSM must be calibrated to the seat track it is controlling. For additional information, refer to Seat Calibration. Once the DSM is calibrated to the seat track, it will only allow movement within the calibrated range.

Seat Calibration

The DSM is calibrated using a scan tool. The calibration procedure automatically powers the driver power seat through its full range of motion and records the full stop positions by monitoring the motor position sensors. Once the full stop positions or range of the seat have been recorded, the DSM will only operate within the calibrated range. Any input attempting to drive the seat beyond the calibrated range will be ignored. This calibration is used for all seat control functions including manual switch control and memory recall positioning. During the seat calibration, the DSM may identify a function that is inoperative, such as a position sensor not changing. If the DSM identifies a concern that has a related diagnostic trouble code (DTC), the DSM will set the related DTC at the end of the validation procedure.

The calibration procedure powers the seat track adjustments to the end of their travel, which is determined by the DSM seeing a change of state in the motor position sensors. If there is a concern with the seat track or motor position sensor that limits the travel, the DSM will interpret the stopping point as the end of travel and store the position. The DSM is not able to determine if the seat has moved to its full travel position. It is only capable of monitoring and storing the amount of travel seen by the position sensor changing states.

For additional information on carrying out the power seat calibration procedure, refer to the scan tool operating manual.

Memory Seat

Memory seat positioning can be recalled with the memory switches on the driver door panel or a programmed remote keyless entry transmitter. In either case, the DSM receives a memory recall 1 or 2 command from the driver door module (DDM) over the SCP communication network. The memory recall switches are a hardwired input to the DDM. The DDM also receives the remote keyless entry transmitter signals. Once a valid memory recall command is received from the DDM, the DSM moves the drivers seat to the position stored in memory by powering the appropriate motors and monitoring the motor position sensors until the position is reached.

Easy Exit/Easy Entry

The easy exit function moves the seat backwards about two inches when the ignition key is removed from the ignition switch. The DSM receives a key out command over the SCP communication network and powers the driver seat rearward. This function will not operate if the seat is less than the travel distance to the end of the track, or the function has been deactivated at the message center driver personality settings. The DSM will also cancel this operation if a valid input command is received, such as the seat regulator control switch or memory recall request.

The DSM will record the current seat position before powering the seat for a easy exit function. This recorded position will be used to return the seat to this position on the easy entry operation. During easy entry operation, the seat is returned to the position previous to the easy exit operation. Easy entry operation will be cancelled if a valid input command is received by the DSM.

Passenger Power Seat

The passenger power seat motors are hardwired to the passenger seat regulator control switch. The circuits are normally at ground through the seat regulator control switch. The individual circuit is switched to power when the specific adjustment position is selected.

Heated Seats

The driver and passenger heated seats share a common battery and ignition feed. A separate shared ignition source supplies the heated seat switches. When the heated seat switch is pressed with the ignition switch in RUN, a momentary voltage signal is sent to the heated seat module. The heated seat module then supplies power to the heating element circuit. The cushion element and seat backrest element are wired in series and powered by the same output. The heated seat module also will ground the separate indicator circuit at the heated seat switch to indicate an ON state. The heated seat module will remain on until the heated seat switch is pressed and a momentary voltage signal is received, or until 10 minutes expire. If the ignition source is removed from the module, the heated seat module will enter an off state and will not return to ON until the switch is once again pressed with the ignition switch in RUN. The heated seat module is designed to heat the seat to 37.5°C (99.5°F) and maintain the temperature until time-out or switched off. This temperature is maintained by the heated seat module monitoring the temperature sensor located in the seat cushion element, and adjusting the current flow to the heating elements.

Inspection and Verification

1. Verify the customer concern by operating the system.

2. Visually inspect for obvious signs of mechanical or electrical damage.

   Visual Inspection Chart

Mechanical	Electrical
• Front seat track motors. • Front seat track binding or obstructed. • Front seat backrest power recline. • Lumbar motor.	• BJB Fuses 411 (15A), 421 (20A), 425 (40A), 428 (20A) • CJB Fuses 205 (5A), 216 (5A), 207 (5A) • Seat regulator control switch. • Memory set switch. • Lumbar seat control switch.

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel. Then select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
   - Check that the program card is correctly installed.
   - Check the connections to the vehicle.
   - Check the ignition switch position.

5. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.

6. Carry out the DATA LINK DIAGNOSTICS test. If the scan tool responds with:
   - CKT 914, CKT 915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for DSM, Go To Pinpoint Test A .
   - NO RESP/NOT EQUIP for DDM, Go To Pinpoint Test B .
   - System passed, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self test diagnostics for the DSM and the DDM.

7. If the DSM DTCs retrieved are related to the concern, go to the DSM Diagnostic Trouble Code (DTC) Index.

8. If the DDM DTCs retrieved are related to the concern, go to the DDM Diagnostic Trouble Code (DTC) Index.

9. If no DTCs related to the concern are retrieved, GO to Symptom Chart to continue the diagnostics.

DSM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1342	ECU Is Defective	DSM	REPEAT the DSM self-test. If DTC B1342 is retrieved again, INSTALL a new DSM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self test.
B1676	Battery Pack Voltage Out of Range	DSM	Go To Pinpoint Test M .
B1703	Seat Driver Recline Forward Switch Circuit Short to Battery	DSM	Go To Pinpoint Test E .
B1707	Seat Driver Recline Rearward Switch Circuit Short to Battery	DSM	Go To Pinpoint Test E .
B1711	Seat Driver Front Up Switch Circuit Short to Battery	DSM	Go To Pinpoint Test E .
B1715	Seat Driver Front Down Switch Circuit Short to Battery	DSM	Go To Pinpoint Test E .
B1719	Seat Driver Forward Switch Circuit Short to Battery	DSM	Go To Pinpoint Test E .
B1723	Seat Driver Rearward Switch Circuit Short to Battery	DSM	Go To Pinpoint Test E .
B1727	Seat Driver Rear Up Switch Circuit Short to Battery	DSM	Go To Pinpoint Test E .
B1731	Seat Driver Rear Down Switch Circuit Short to Battery	DSM	Go To Pinpoint Test E .
B1757	Seat Driver Rear Down Circuit Failure	DSM	Go To Pinpoint Test E .
B1761	Seat Driver Front Down Circuit Failure	DSM	Go To Pinpoint Test E .
B1765	Seat Driver Forward Circuit Failure	DSM	Go To Pinpoint Test E .
B1769	Seat Driver Backward Circuit Failure	DSM	Go To Pinpoint Test E .

B2143	NVM Memory Failure	DSM	CARRY OUT seat calibration of the DSM. CLEAR the DTCs. REPEAT the self test. IF the DTC resets, INSTALL a new DSM. REFER to Section 419-10 . CARRY OUT seat calibration of the new DSM.
B2146	Seat Recline Motor Position Out of Range	DSM	Go To Pinpoint Test E .
B2149	Seat Front Vertical Motor Position Out of Range	DSM	Go To Pinpoint Test E .
B2152	Seat Rear Vertical Motor Position Out of Range	DSM	Go To Pinpoint Test E .
B2155	Seat Horizontal Motor Position Out of Range	DSM	Go To Pinpoint Test E .
B2158	Seat Recline Motor Memory Position Out of Range	DSM	Go To Pinpoint Test G .
B2161	Seat Front Vertical Motor Memory Position Out of Range	DSM	Go To Pinpoint Test G .
B2164	Seat Rear Vertical Motor Memory Position Out of Range	DSM	Go To Pinpoint Test G .
B2167	Seat Horizontal Motor Memory Position Out of Range	DSM	Go To Pinpoint Test G .

DDM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1309	Power Door Lock Circuit Short to Ground	DDM	REFER to Section 501-14B .
B1341	Power Door Unlock Circuit Short to Ground	DDM	REFER to Section 501-14B .
B1342	ECU Is Defective	DDM	CLEAR the DTC. REPEAT the DDM self-test. If DTC B1342 is retrieved, INSTALL a new DDM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test.
B1400	Driver Power Window One Touch Window Relay Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1405	Driver Power Window Down Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1408	Driver Power Window Up Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1416	Power Window LR Motor Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1420	Passenger Power Window Motor Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1424	Power Window RR Motor Circuit Short to Battery	DDM	REFER to Section 501-11 .

B1530	Memory Set Switch Circuit Short to Ground	DDM	REFER to Section 501-09 .
B1534	Memory 1 Switch Circuit Short to Ground	DDM	REFER to Section 501-09 .
B1538	Memory 2 Switch Circuit Short to Ground	DDM	REFER to Section 501-09 .
B1676	Battery Pack Voltage Out of Range	DDM	REFER to Section 419-10 .
B2112	Door Driver Set Switch Stuck Failure	DDM	REFER to Section 501-14B .
B2116	Door Driver Reset Switch Stuck Failure	DDM	REFER to Section 501-14B .
B2320	Mirror Driver Horizontal Feedback Potentiometer Circuit Failure	DDM	REFER to Section 501-09 .
B2324	Mirror Driver Vertical Feedback Potentiometer Circuit Failure	DDM	REFER to Section 501-09 .
B2336	Mirror Switch Assembly Circuit Failure	DDM	REFER to Section 501-09 .
B2425	Remote Keyless Entry Out of Synchronization	DDM	REFER to Section 501-14B .
B2477	Module Configuration Failure	DDM	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test. REFER to Section 206-09B .
U1059	SCP (J1850) Invalid or Missing Data for Transmission / Transaxle / PRNDL	PCM	CARRY OUT the PCM self-test. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart

Symptom Chart
Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE DRIVER SEAT MODULE (DSM)

PINPOINT TEST B: NO COMMUNICATION WITH THE DRIVER DOOR MODULE (DDM)

PINPOINT TEST C: THE POWER SEAT IS INOPERATIVE DRIVER

PINPOINT TEST D: THE POWER SEAT IS INOPERATIVE PASSENGER

PINPOINT TEST E: THE MEMORY SEAT DOES NOT MOVE HORIZONTALLY/VERTICALLY DRIVER

PINPOINT TEST F: THE POWER SEAT DOES NOT MOVE HORIZONTALLY/VERTICALLY PASSENGER

PINPOINT TEST G: THE MEMORY SEAT IS INOPERATIVE

PINPOINT TEST H: THE HEATED SEAT IS INOPERATIVE DRIVER

PINPOINT TEST I: THE HEATED SEAT IS INOPERATIVE PASSENGER

PINPOINT TEST J: THE HEATED SEATS ARE INOPERATIVE

PINPOINT TEST K: THE POWER LUMBAR IS INOPERATIVE DRIVER

PINPOINT TEST L: THE POWER LUMBAR IS INOPERATIVE PASSENGER

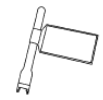
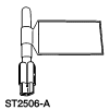
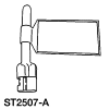
PINPOINT TEST M: DTC B1676 BATTERY PACK VOLTAGE OUT OF RANGE

PINPOINT TEST N: THE POWER SEAT DOES NOT MOVE HORIZONTALLY/VERTICALLY DRIVER

PINPOINT TEST E: THE MEMORY SEAT DOES NOT MOVE HORIZONTALLY/VERTICALLY DRIVER

Supplemental Restraint System (SRS) Deactivation and Reactivation

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F395
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Deactivation

⚠ WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

⚠ WARNING: The safety belt buckle pretensioner and safety belt retractor pretensioner are pyrotechnic devices. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

⚠ WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

⚠ WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.**

NOTE: Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors.

NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road.**

NOTE: After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

1. ⚠ **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

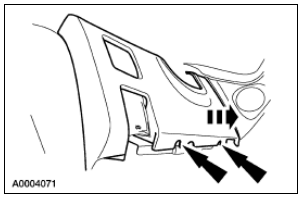
   Please refer to the appropriate vehicle workshop manual to determine location of the front air bag sensors.

   The side air bag sensors are located at or near the base of the B-pillar.

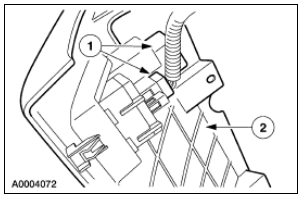
   To deplete the backup power supply energy, Disconnect the battery ground cable and wait at least one minute to allow for the depletion of the restraint system backup power supply. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

   Disconnect the battery ground cable and wait at least one minute to allow for the depletion of the restraint system backup power supply. For additional information, refer to Section 414-01 .

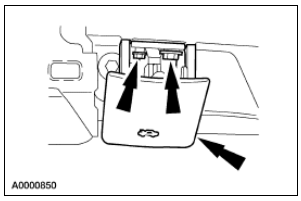
2. Remove the two screws and pull out on the lower steering column opening finish panel enough to access the electrical connectors.



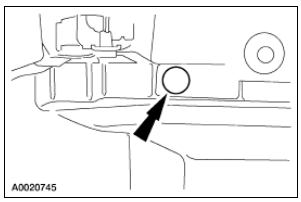
3. Remove the lower steering column opening finish panel.
   1. Disconnect the electrical connectors.
   2. Remove the lower steering column opening finish panel.



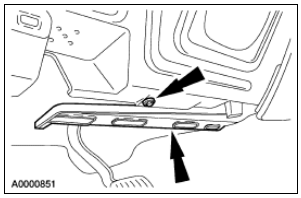
4. Remove the screws. Separate the hood latch release cable and handle assembly from the steering column opening reinforcement.



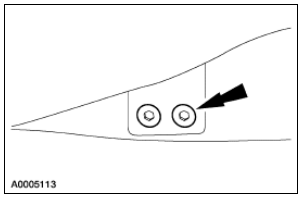
5. Remove the two pin-type retainers and the RH instrument panel insulator.
   - Disconnect the courtesy lamp.



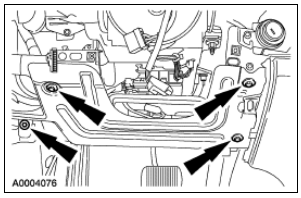
6. Remove the screw and the heater duct.



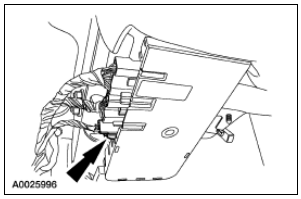
7. Loosen the two driver-side instrument panel tunnel brace bolts.
   - Position the carpet aside to gain access to the bolts.



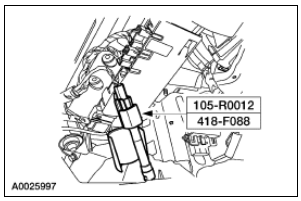
8. Remove the screws and the steering column opening reinforcement.



9. Disconnect the clockspring electrical connector at the base of the steering column.

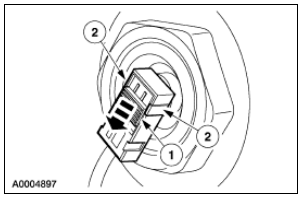


10. Attach the restraint system diagnostic tool to the vehicle harness side of the clockspring electrical connector.

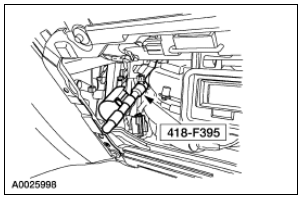


11. Remove the glove compartment. For additional information, refer to Section 501-12 .

12. Disconnect the passenger air bag module electrical connector.
    1. Reaching into the glove box opening toward the center of the instrument panel, under the cross-car beam, slide and disengage the passenger air bag module electrical connector locking clip.
    2. Push in on the two release tabs and disconnect the passenger air bag module electrical connector.



13. Attach the restraint system diagnostic tool to the vehicle harness side of the passenger air bag electrical connector.



14. Connect the battery ground cable. For additional information, refer to Section 414-01 .

15. Move and tilt the front seats to their highest and most forward position.

16. ⚠ **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

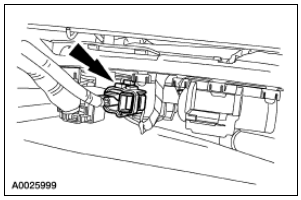
    Please refer to the appropriate vehicle workshop manual to determine location of the front air bag sensors.

    The side air bag sensors are located at or near the base of the B-pillar.

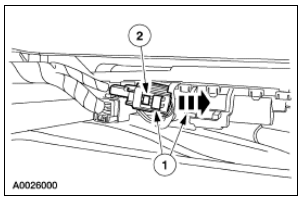
    To deplete the backup power supply energy, Disconnect the battery ground cable and wait at least one minute to allow for the depletion of the restraint system backup power supply. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute to allow for the depletion of the restraint system backup power supply. For additional information, refer to Section 414-01 .

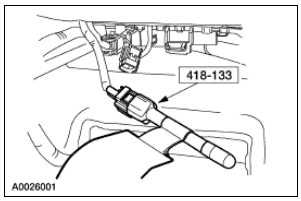
17. From under the passenger seat, release the tab on the connector bracket and remove the passenger seat side air bag electrical connector.



18. Disconnect the passenger seat side air bag electrical connector.
    1. Slide and disengage the passenger seat side air bag electrical connector locking clip.
    2. Push in to release the tab and disconnect the passenger seat side air bag electrical connector.



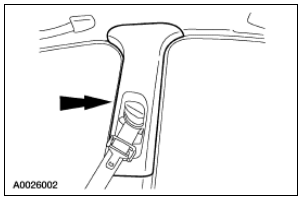
19. Attach the restraint system diagnostic tool to the passenger seat side air bag floor electrical connector.



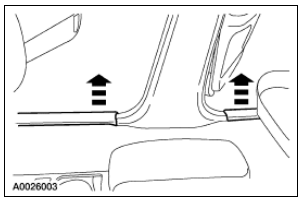
20. Remove the passenger side B-pillar weatherstripping.

21. Position the safety belt D-ring to its highest point.

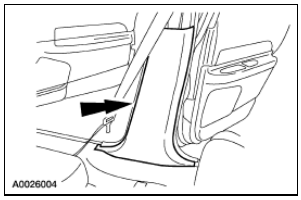
22. Remove the passenger side B-pillar upper trim panel.



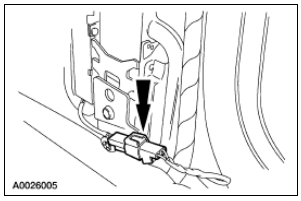
23. Remove the passenger side front and rear door scuff plates.



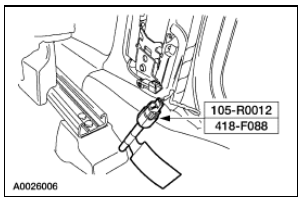
24. Remove the passenger side B-pillar lower trim panel.



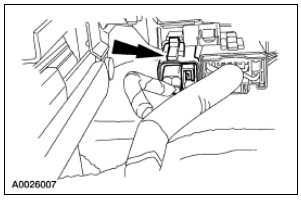
25. Disconnect the passenger side safety belt retractor pretensioner floor electrical connector.



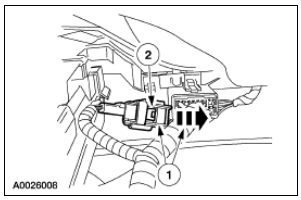
26. Attach the restraint system diagnostic tool to the passenger side safety belt retractor pretensioner floor electrical connector.



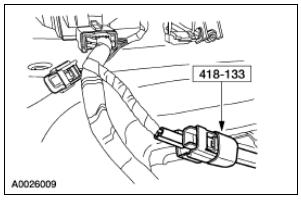
27. From under the driver seat, release the tab on the connector bracket and remove the driver seat side air bag electrical connector.



28. Disconnect the driver seat side air bag electrical connector.
    1. Slide and disengage the driver seat side air bag electrical connector locking clip.
    2. Push down to release the tab and disconnect the driver seat side air bag electrical connector.



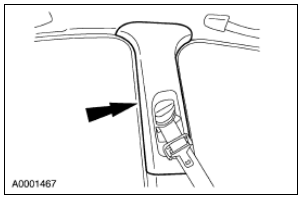
29. Attach the restraint system diagnostic tool to the driver seat side air bag floor electrical connector.



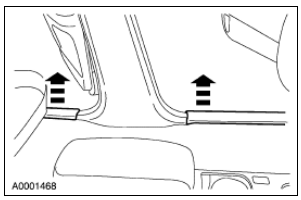
30. Remove the driver side B-pillar weatherstripping.

31. Position the safety belt D-ring to its highest point.

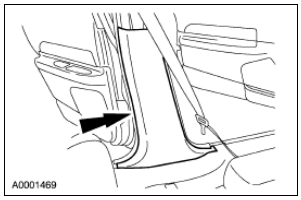
32. Remove the driver side B-pillar upper trim panel.



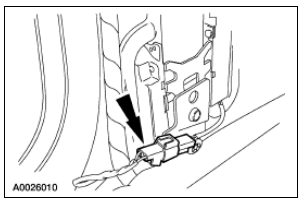
33. Remove the driver side front and rear door scuff plates.



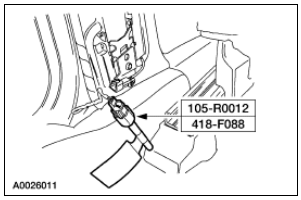
34. Remove the driver side B-pillar lower trim panel.



35. Disconnect the driver side safety belt retractor pretensioner electrical connector.



36. Attach the restraint system diagnostic tool to the driver side safety belt retractor pretensioner floor electrical connector.



37. Connect the battery ground cable. For additional information, refer to Section 414-01 .

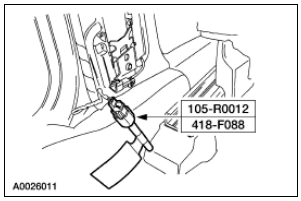
38. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

39. Disconnect the battery ground cable and wait at least one minute to allow for the depletion of the restraint system backup power supply. For additional information, refer to Section 414-01 .

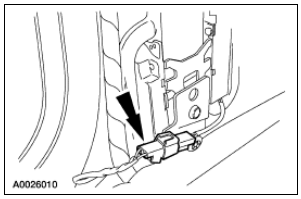
Reactivation

⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings and notes at the beginning of the deactivation procedure.

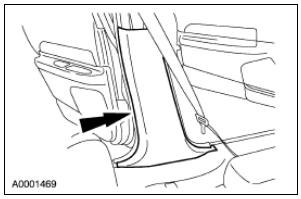
1. Remove the restraint system diagnostic tool from the driver side safety belt retractor pretensioner floor electrical connector.



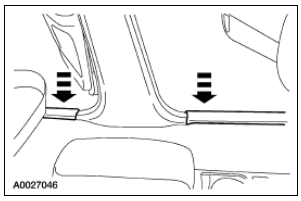
2. Connect the driver side safety belt retractor pretensioner electrical connector.



3. Install the driver side B-pillar lower trim panel.

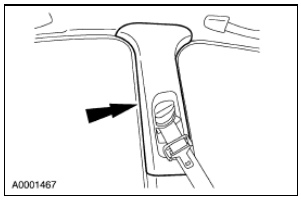


4. Install the driver side front and rear door scuff plates.



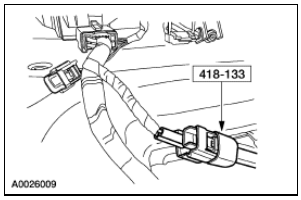
5. **NOTE:** Position the safety belt D-ring to its highest point.

   Install the driver side B-pillar upper trim panel.

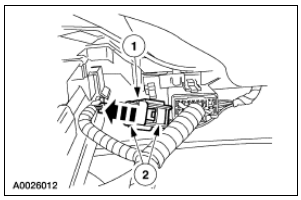


6. Install the driver side B-pillar weatherstripping.

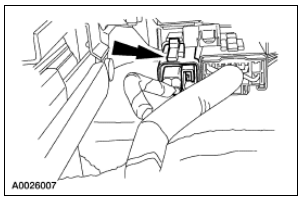
7. Remove the restraint system diagnostic tool from the driver seat side air bag floor electrical connector.



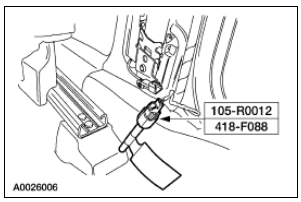
8. Connect the driver seat side air bag electrical connector.
    1. Connect the driver seat side air bag electrical connector.
    2. Slide and engage the driver seat side air bag electrical connector locking clip.



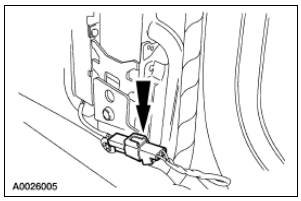
9. Install the driver seat side air bag electrical connector onto the connector bracket under the driver seat.



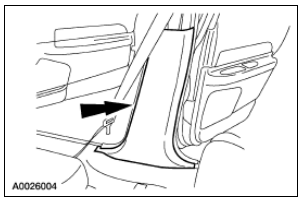
10. Remove the restraint system diagnostic tool from the passenger side safety belt retractor pretensioner electrical connector.



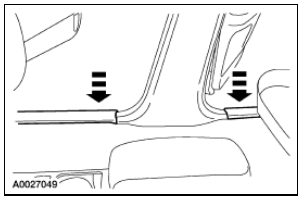
11. Connect the passenger side safety belt retractor pretensioner electrical connector.



12. Install the passenger side B-pillar lower trim panel.

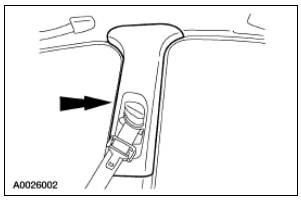


13. Install the passenger side front and rear door scuff plates.



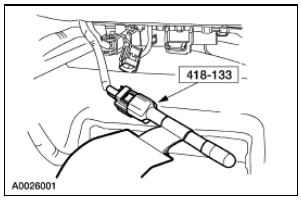
14. **NOTE:** Position the safety belt D-ring to its highest point.

    Install the passenger side B-pillar upper trim panel.

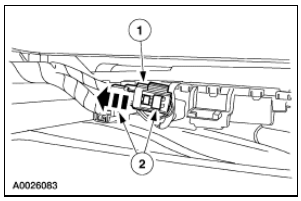


15. Install the passenger side B-pillar weatherstripping.

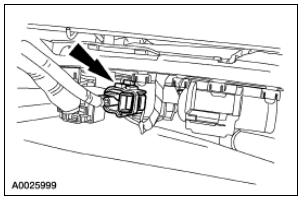
16. Remove the restraint system diagnostic tool from the passenger seat side air bag floor electrical connector.



17. Connect the passenger seat side air bag electrical connector.
    1. Connect the passenger seat side air bag electrical connector.
    2. Slide and engage the passenger seat side air bag electrical connector locking clip.



18. Install the passenger seat side air bag electrical connector onto the connector bracket under the passenger seat.



19. Connect the battery ground cable. For additional information, refer to Section 414-01 .

20. Position the front seats rearward.

21. ⚠ **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag**

supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

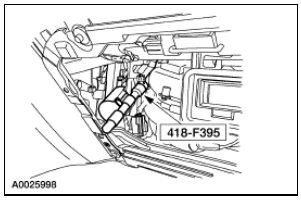
Please refer to the appropriate vehicle workshop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

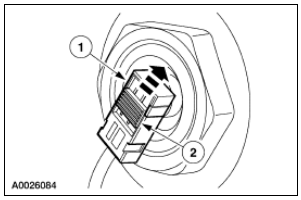
To deplete the backup power supply energy, Disconnect the battery ground cable and wait at least one minute to allow for the depletion of the restraint system backup power supply. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute to allow for the depletion of the restraint system backup power supply. For additional information, refer to Section 414-01 .

22. Remove the restraint system diagnostic tool from the vehicle harness side of the passenger air bag electrical connector.

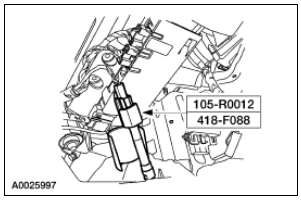


23. Connect the passenger air bag module electrical connector.
    1. Reach into the glove box opening toward the center of the instrument panel, under the cross-car beam and connect the passenger air bag module electrical connector.
    2. Slide and engage the passenger air bag module electrical connector locking clip.

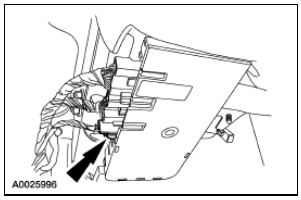


24. Install the glove compartment. For additional information, refer to Section 501-12 .

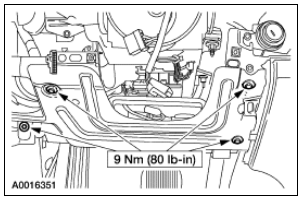
25. Remove the restraint system diagnostic tool from the vehicle harness side of the clockspring electrical connector.



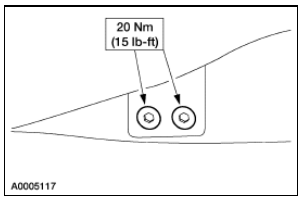
26. Connect the clockspring electrical connector at the base of the steering column.



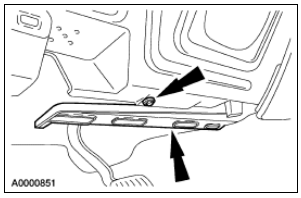
27. Position the steering column opening reinforcement and install the screws.



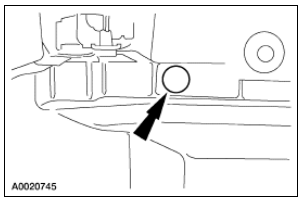
28. Tighten the two driver-side instrument panel tunnel brace bolts.
    - Reposition the carpet.



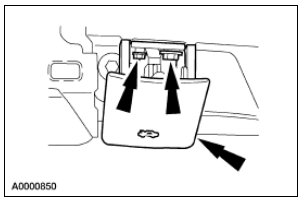
29. Position the heater duct and install the screw.



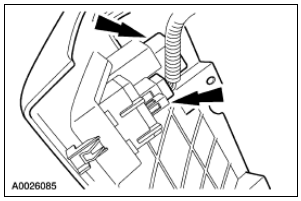
30. Install the RH instrument panel insulator and the two pin-type retainers.
    - Connect the courtesy lamp.



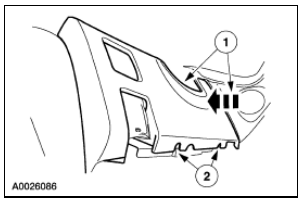
31. Position the hood latch release cable and handle assembly to the steering column opening reinforcement and install the screws.



32. Connect the electrical connectors to the switches in the lower steering column opening finish panel.



33. Install the lower steering column opening finish panel to the instrument panel.
    1. Position the lower steering column opening finish panel to the instrument panel and push in, seating the retaining clips.
    2. Install the screws.



34. Connect the battery ground cable. For additional information, refer to Section 414-01 .

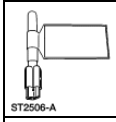
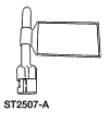
35. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

36. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Seat Control Switch

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F395
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Removal

⚠ WARNING: Always wear safety glasses when repairing a air bag supplemental restraint system (SRS) vehicle and when handling an airbag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

NOTE: The left side is shown, the right side is similar.

1. Prepare the vehicle for seat control switch removal.
    1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

       Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

       The side air bag sensors are located at or near the base of the B-pillar.

       To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute.

       Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .
    2. **⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system (SRS) deactivation and reactivation procedure.**

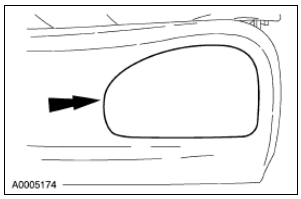
Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

3. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

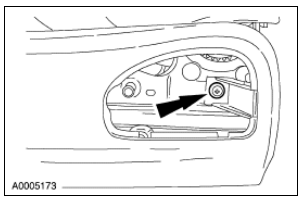
   Remove the affected seat. For additional information, refer to Front Seat in this section.

2. ⚠ **CAUTION: Do not use a screwdriver to remove the safety belt cover.**

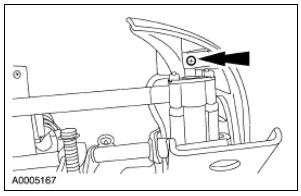
Remove the front safety belt cover by placing fingers behind the cover and pushing outward.



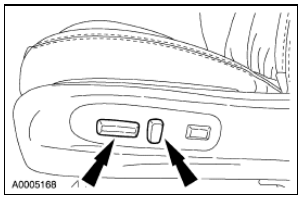
3. Remove the side trim panel screw.



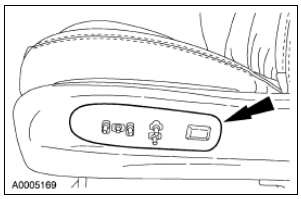
4. Remove the side trim panel screw.



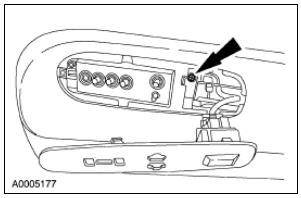
5. Remove the seat control knobs.



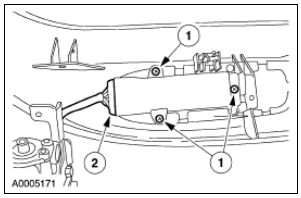
6. Position the seat regulator control switch plate aside.



7. Remove the screw and set aside the front cushion side shield.



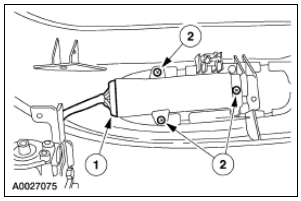
8. Remove the seat regulator control switch.
    1. Remove the screws.
    2. Disconnect the electrical connector.



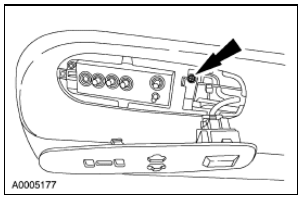
Installation

⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

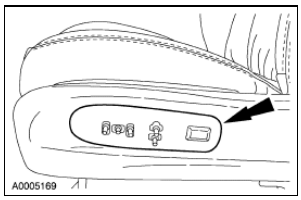
1. Install the seat regulator control switch.
    1. Connect the electrical connector.
    2. Install the screws.



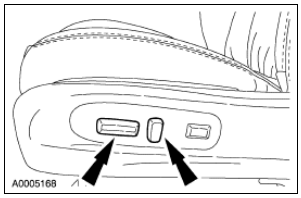
2. Position the front cushion side shield and install the screw.



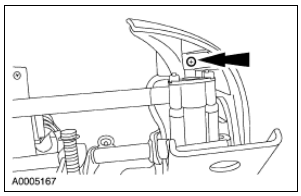
3. Install the seat regulator control switch plate.



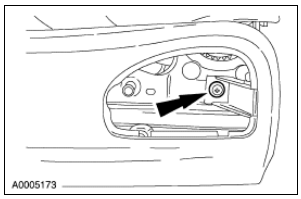
4. Install the seat control knobs.



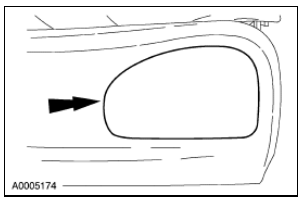
5. Install the side trim panel screw.



6. Install the side panel trim screw.



7. Install the front safety belt cover.



8. Restore the vehicle to operating condition.
    1. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the seat removal and installation procedure.**

       Install the affected seat. For additional information, refer to Front Seat in this section.
    2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system (SRS) deactivation and reactivation procedure.**

       Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
    3. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

       With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .
    4. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Heated Seat Switch

Removal and Installation

All vehicles

1. Apply the parking brake.

Vehicles with manual transmission

2. If equipped with a manual transmission, place the selector lever in fourth gear.

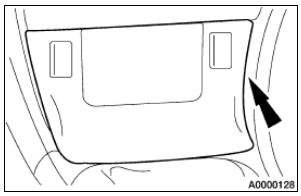
Vehicles with automatic transmission

3. If equipped with an automatic transmission, place the selector lever in NEUTRAL.

All vehicles

4. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

5. Remove the ashtray finish panel.



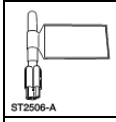
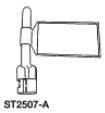
6. Remove the two screws and the ashtray assembly.
   - Disconnect the electrical connectors.

7. Release the locking tabs and remove the heated seat switch.

8. To install, reverse the removal procedure.

Lumbar Control Switch

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F395
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Removal

⚠ WARNING: Always wear safety glasses when repairing a air bag supplemental restraint system (SRS) vehicle and when handling an airbag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

NOTE: The left side is shown, the right side is similar.

1. Prepare the vehicle for lumbar control switch removal.
    1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

       Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

       The side air bag sensors are located at or near the base of the B-pillar.

       To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

       Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .
    2. **⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system (SRS)**

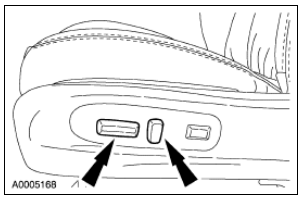
deactivation and reactivation procedure.

Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

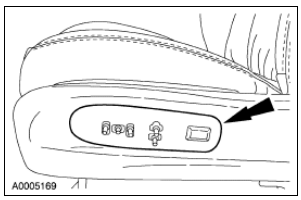
3. **⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

   Remove the affected seat. For additional information, refer to Front Seat in this section.

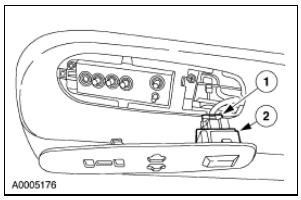
2. Remove the seat control knobs.



3. Position the seat regulator control switch plate aside.



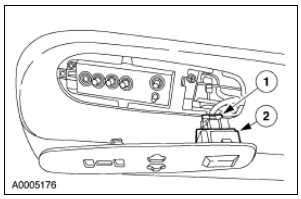
4. Remove the lumbar control switch.
   1. Disconnect the connector.
   2. Remove the lumbar control switch.



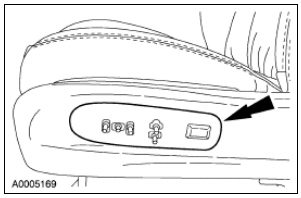
Installation

⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

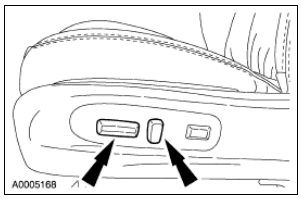
1. Install the lumbar control switch.
   1. Connect the electrical connector.
   2. Install the lumbar control switch.



2. Install the seat regulator control switch plate.



3. Install the seat control knobs.



4. Restore the vehicle to operating condition.
    1. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the seat removal and installation procedure.**

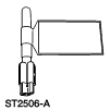
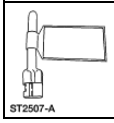
       Install the affected seat. For additional information, refer to Front Seat in this section.
    2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation and reactivation procedure.**

       Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
    3. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

       With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .
    4. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Front Seat Backrest

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Removal

All seats

⚠ WARNING: Always wear safety glasses when repairing a air bag supplemental restraint system (SRS) vehicle and when handling an airbag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

NOTE: If a side air bag deployment took place the seatback pad, trim cover, and side air bag module must be replaced. The seatback frame should be replaced if necessary.

NOTE: The left side is shown, the right side is similar.

1. Prepare the vehicle for front seat backrest removal.
    1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

       Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

       The side air bag sensors are located at or near the base of the B-pillar.

       To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system (SRS) deactivation and reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
3. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

   Remove the affected seat. For additional information, refer to Front Seat in this section.

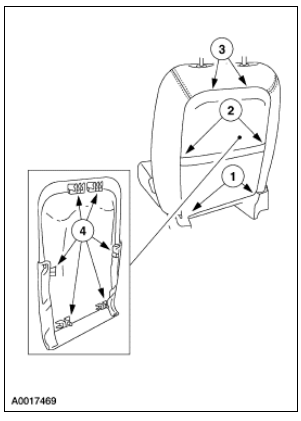
2. ⚠ **WARNING: Front seat back trim covers installed on seats equipped with side air bags cannot be repaired, they are to be replaced (cleaning is permissible).**

   ⚠ **CAUTION: When removing the seat backrest trim panel, be careful not to damage the J-hooks. If the seat backrest trim panel J-hooks are damaged, install a new seat backrest trim panel.**

   ⚠ **CAUTION: When removing the seat backrest trim panel, be careful not to damage the pin-type retainers. Pulling towards you, use a smooth, controlled force to release the pin-type retainers.**

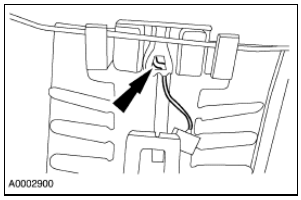
   Remove the seat backrest trim panel.

   1. Pull and release the pin-type retainers at the bottom of the seat backrest trim panel.
   2. While holding the seat backrest trim panel at the bottom, push in on the left side of the panel at the lip of the map pocket and slide it to the right to disengage the J-hook. Repeat this process for the right side J-hook but slide the panel to the left to disengage the hook.
   3. While pushing in at the top of the seat backrest trim panel, slide it down to disengage the top J-hooks.
   4. Remove the seat backrest trim panel and inspect the J-hooks and pin-type retainers for damage.

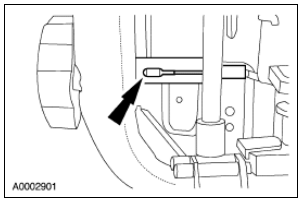


Seats with manual lumbar

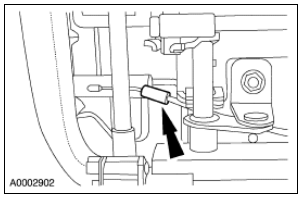
3. Remove the retaining hook.



4. Align the end of the adjusting cable in the slot.

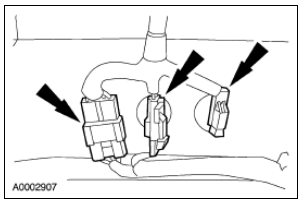


5. Release the adjusting cable.

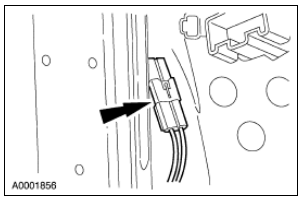


All seats

6. Disconnect the electrical connectors.

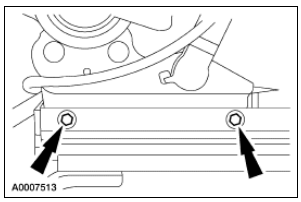


7. Disconnect the electrical connector.



8. Remove the front cushion side shield trim panel. For additional information, refer to Seat - Front Cushion Side Shield in this section.

9. Remove the two front seat backrest bolts on each side. Remove the front seat backrest.

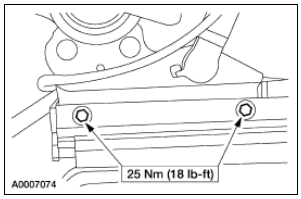


Installation

⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings and notes at the beginning of the removal procedure.

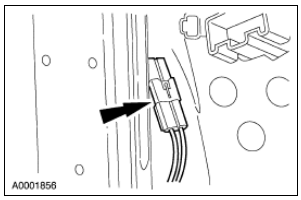
All seats

1. Position the front seat backrest and install two bolts on each side.

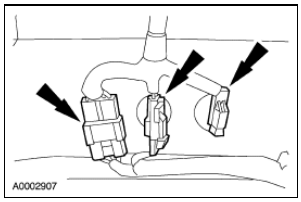


2. Install the front cushion side shield trim panel. For additional information, refer to Seat - Front Cushion Side Shield in this section.

3. Connect the electrical connector.

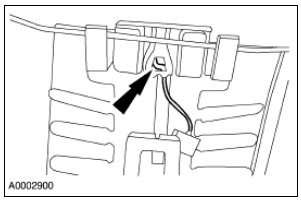


4. Connect the electrical connectors.

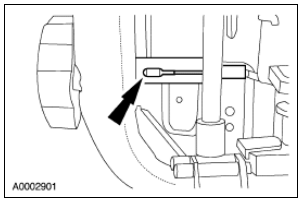


Seats with manual lumbar

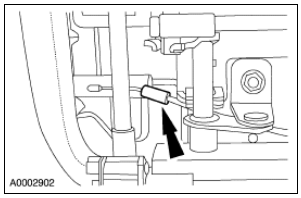
5. Install the retaining hook.



6. Align the end of the adjusting cable in the slot.



7. Install the adjusting cable.

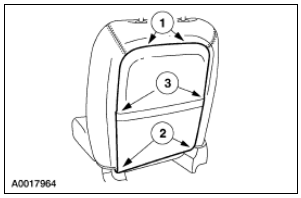


8. ⚠ **CAUTION: Inspect the seat backrest trim panel J-hooks for damage. If damaged, install a new seat backrest trim panel.**

   NOTE: If re-installing the original seat backrest trim panel, install new pin-type retainers.

   Install the seat backrest trim panel.

   1. Angle the top of the seat backrest trim panel inward and up to engage the upper J-hooks to the seat backrest frame.
   2. While holding the seat backrest trim panel up, align the pin-type retainers at the bottom of the seat backrest trim panel and install them into the seat backrest frame.
   3. With the palm of your hand, install the J-clips by pushing down on the seat backrest trim panel and towards the center of the seat.
      - ♦ Check the retention of the seat backrest trim panel by lightly pulling on the bottom, sides, and top where the retainers are located.



9. Restore the vehicle to operating condition.
   1. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the seat removal and installation procedure.**

      Install the affected seat. For additional information, refer to Front Seat in this section.
   2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation and reactivation procedure.**

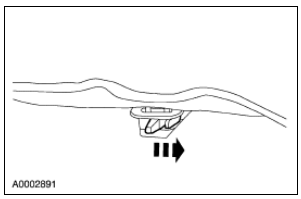
      Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
   3. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

      With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .
   4. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Seat Backrest Rear Side Bolsters

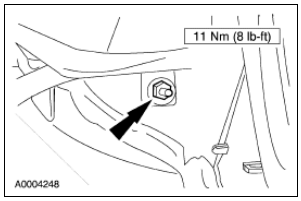
Removal and Installation

1. Remove the rear seat cushions. For additional information, refer to Seat Rear Cushion .



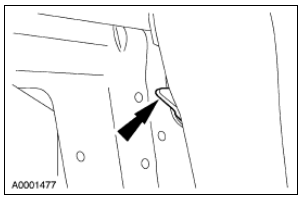
2. From the luggage compartment, release and fold down the seat backrest.

3. Remove the rear seat bolster nut.



4. **NOTE:** Pull down the lever to release the LH latch. Push up the lever to release the RH latch.

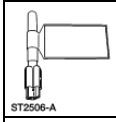
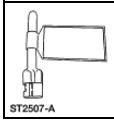
   Release the latch and remove the rear seat bolster.



5. To install, reverse the removal procedure.

Front Seat

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Removal

⚠ WARNING: Always wear safety glasses when repairing a air bag supplemental restraint system (SRS) vehicle and when handling an airbag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

NOTE: The driver seat is shown, the passenger seat is similar.

NOTE: If a side air bag deployment took place the seatback pad, trim cover, and side air bag module must be replaced. The seatback frame should be replaced if necessary.

1. Prepare the vehicle for seat removal.
    1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

       Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

       The side air bag sensors are located at or near the base of the B-pillar.

       To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

       Disconnect the battery ground cable (14301) and wait at least one minute. For additional

information, refer to Section 414-01 .

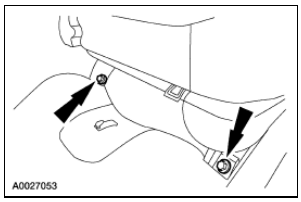
2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation and reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

2. Reconnect the battery ground cable.

3. Move the seat rearward.

4. Remove the bolts.

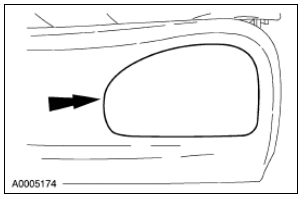


5. Position the seat forward.

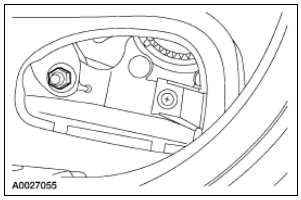
6. Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

7. ⚠ **CAUTION: Do not use a screwdriver to remove the safety belt cover.**

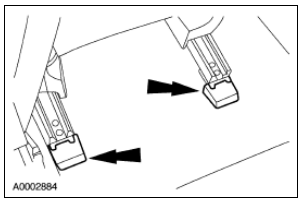
   Remove the safety belt cover by placing fingers behind the cover and pushing outward.



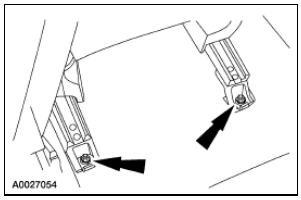
8. Remove the nut and the front safety belt.



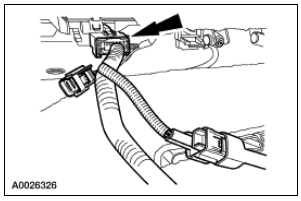
9. Remove the seat track rear covers.



10. Remove the nuts.



11. Disconnect the electrical connector.



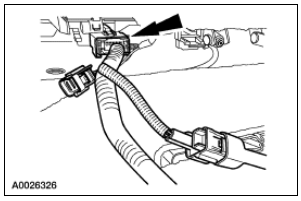
12. Remove the seat.

Installation

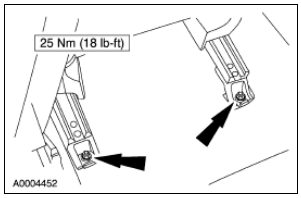
⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

1. Position the seat in the vehicle.

2. Connect the electrical connectors.

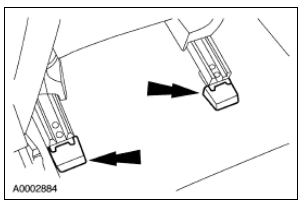


3. Install the nuts.



4. **NOTE:** Make sure the seat track covers are positioned below the level of the seat track rail to prevent damage to the cover during seat travel.

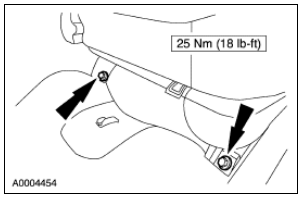
   Install the seat track rear covers.



5. Connect the battery ground cable. For additional information, refer to Section 414-01 .

6. Position the seat rearward.

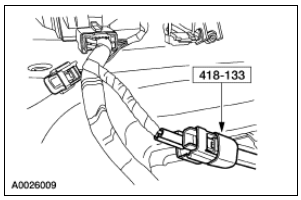
7. Install the bolts.



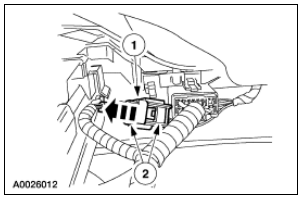
8. Position the seat forward.

9. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

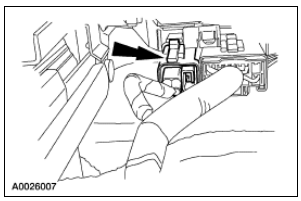
10. Remove the restraint system diagnostic tool from the driver seat side air bag floor electrical connector.



11. Connect the driver seat side air bag electrical connector.
    1. Connect the driver seat side air bag electrical connector.
    2. Slide and engage the driver seat side air bag electrical connector locking clip.



12. Install the driver seat side air bag electrical connector onto the connector bracket under the driver seat.



13. Connect the battery ground cable. For additional information, refer to Section 414-01 .

14. With the restrain system diagnostic tools still installed at the remaining deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

15. ⚠ **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

    Please refer to the appropriate vehicle shop manual to determine location of the front air bag

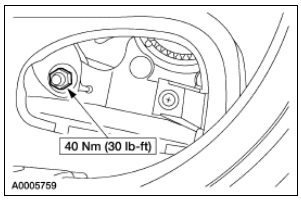
sensors.

The side air bag sensors are located at or near the base of the B-pillar.

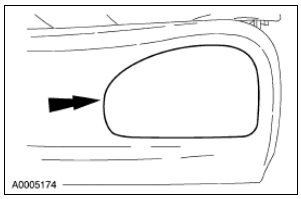
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

16. Install the front safety belt.
    1. Install the safety belt.
    2. Install the bolt.



17. Install the safety belt cover.



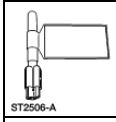
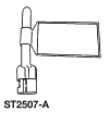
18. Restore the vehicle to operating condition.
    1. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation and reactivation procedure.**

       Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
    2. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

       With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .
    3. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Seat Front Cushion Side Shield

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Removal and Installation

⚠ WARNING: Always wear safety glasses when repairing a air bag supplemental restraint system (SRS) vehicle and when handling an airbag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

NOTE: The left side is shown, the right side is similar.

1. Prepare the vehicle for front cushion side shield removal.
    1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

       Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

       The side air bag sensors are located at or near the base of the B-pillar.

       To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

       Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .
    2. **⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system (SRS)**

deactivation and reactivation procedure.

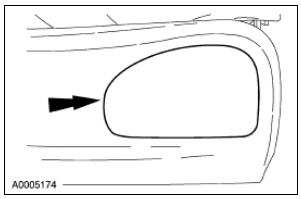
Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

3. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

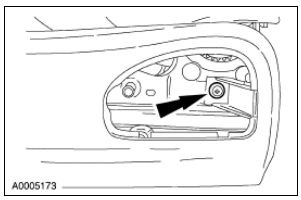
   Remove the affected seat. For additional information, refer to Front Seat in this section.

2. ⚠ **CAUTION: Do not use a screwdriver to remove the safety belt cover.**

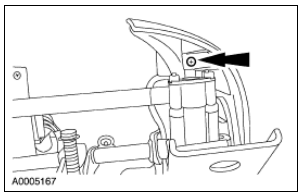
   Remove the safety belt cover by placing fingers behind the cover and pushing outward.



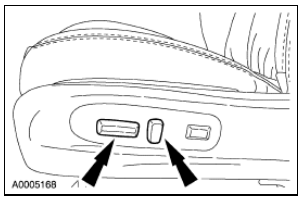
3. Remove the front cushion side shield screw.



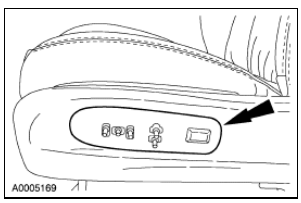
4. Remove the front cushion side shield screw.



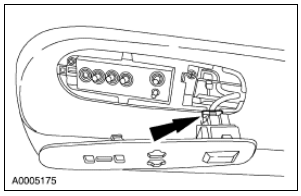
5. Remove the seat control switch knobs.



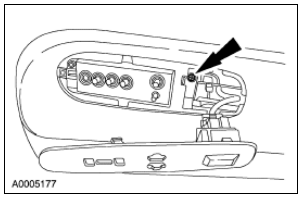
6. Position the seat control switch plate aside.



7. Disconnect the lumbar control switch electrical connector.



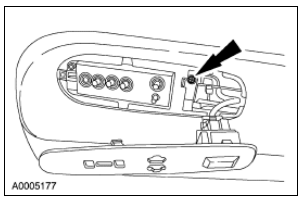
8. Remove the screw and the front cushion side shield.



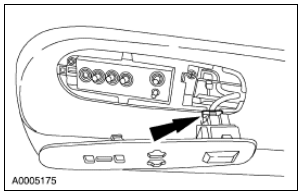
Installation

⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

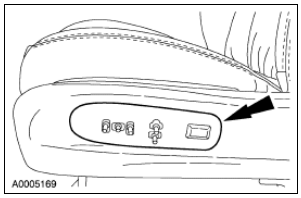
1. Install the front cushion side shield. Install the screw.



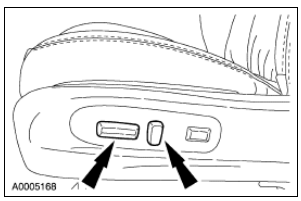
2. Connect the lumbar control switch electrical connector.



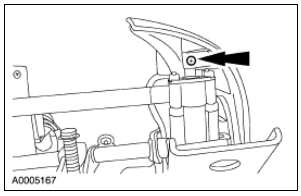
3. Install the seat regulator control switch plate.



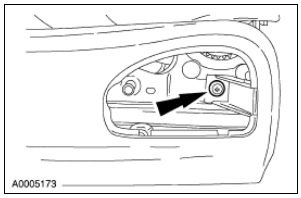
4. Install the seat control switch knobs.



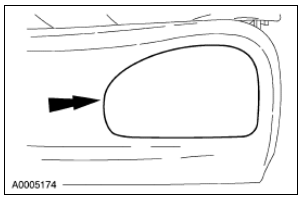
5. Install the front cushion side shield screw.



6. Install the front cushion side shield screw.



7. Install the safety belt cover.



8. Restore the vehicle to operating condition.
    1. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the seat removal and installation procedure.**

       Install the affected seat. For additional information, refer to Front Seat in this section.
    2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation and reactivation procedure.**

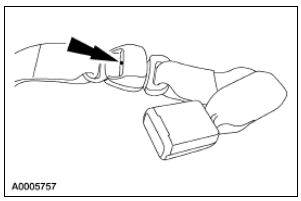
       Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
    3. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

       With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .
    4. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

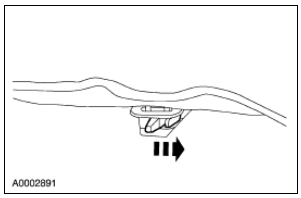
Seat Rear Cushion

Removal and Installation

1. Using a suitable tool, release the mini-buckle.



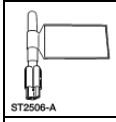
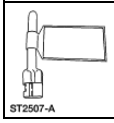
2. Release the two latches and remove the rear seat cushion.



3. To install, reverse the removal procedure.
   - Check the restraint system for correct operation.

Seat Track

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Removal

⚠ WARNING: Always wear safety glasses when repairing a air bag supplemental restraint system (SRS) vehicle and when handling an airbag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

⚠ CAUTION: Use care when handling the seat and track assembly. Dropping the assembly or sitting on a seat not secured in the vehicle may result in damaged components.

NOTE: The left side is shown, the right side is similar.

1. Prepare the vehicle for seat track removal.
    1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

       Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

       The side air bag sensors are located at or near the base of the B-pillar.

       To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

       Disconnect the battery ground cable (14301) and wait at least one minute. For additional

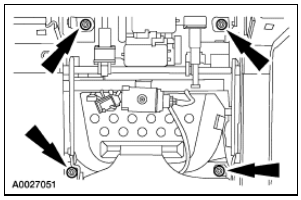
information, refer to Section 414-01 .

2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation and reactivation procedure.**

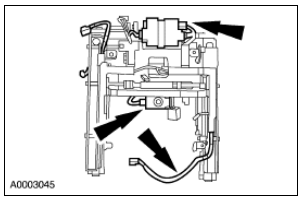
   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
3. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

   Remove the affected seat. For additional information, refer to Front Seat in this section.
4. Remove the front cushion side shield. For additional information, refer to Seat Front Cushion Side Shield in this section.
5. Remove the seat backrest. For additional information, refer to Front Seat Backrest in this section.

2. Remove the nuts and the seat track.



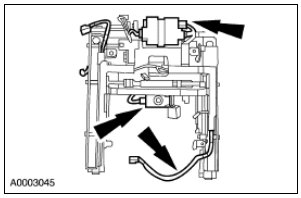
3. Remove the wiring harness, driver seat module, seat track trim panel, and if equipped, the heated seat module.



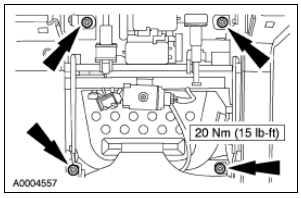
Installation

⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.**

1. Install the wiring harness, driver seat module, seat track trim panel, and if equipped, the heated seat module.



2. Install the seat track and nuts.



3. Restore the vehicle to operating condition.
    1. Install the seat backrest. For additional information, refer to Front Seat Backrest in this section.
    2. Install the front cushion side shield. For additional information, refer to Seat Front Cushion Side Shield in this section.
    3. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the seat removal and installation procedure.**

       Install the affected seat. For additional information, refer to Front Seat in this section.
    4. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation and reactivation procedure.**

       Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
    5. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

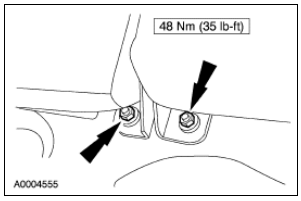
       With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .
    6. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Seat Rear Seatback

Removal and Installation

1. From the luggage compartment, release and fold down the seat backrest.

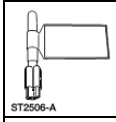
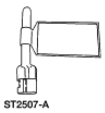
2. Remove the rear seat backrest nuts and remove the seat backrest.



3. To install, reverse the removal procedure.

Heated Seat Module

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Removal

⚠ WARNING: Always wear safety glasses when repairing a air bag supplemental restraint system (SRS) vehicle and when handling an airbag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

NOTE: The left side is shown, the right side is similar.

1. Prepare the vehicle for heated seat module removal.
    1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

       Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

       The side air bag sensors are located at or near the base of the B-pillar.

       To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

       Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .
    2. **⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS)**

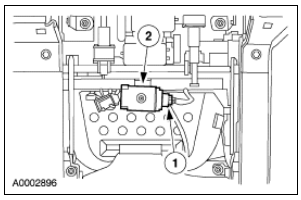
deactivation and reactivation procedure.

Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

3. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

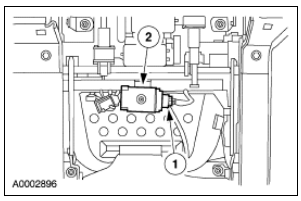
   Remove the affected seat. For additional information, refer to Front Seat in this section.

2. Remove the heated seat module.
   1. Disconnect the electrical connector.
   2. Remove the module.



Installation

1. Install the heated seat module.
   1. Connect the electrical connector.
   2. Install the module.



2. Restore the vehicle to operating condition.
   1. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the seat removal and installation procedure.**

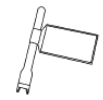
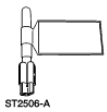
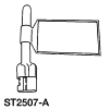
      Install the affected seat. For additional information, refer to Front Seat in this section.
   2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation and reactivation procedure.**

      Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
   3. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

      With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .
   4. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Motor Front Seat Lumbar

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Removal

⚠ WARNING: Always wear safety glasses when repairing a air bag supplemental restraint system (SRS) vehicle and when handling an airbag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

NOTE: The left side is shown, the right side is similar.

1. Prepare the vehicle for front seat lumbar motor removal.
    1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

       Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

       The side air bag sensors are located at or near the base of the B-pillar.

       To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

       Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .
    2. **⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS)**

deactivation and reactivation procedure.

Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

3. **⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

   Remove the affected seat. For additional information, refer to Front Seat in this section.

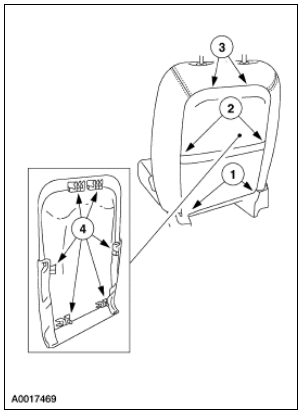
2. **⚠ WARNING: Front seat back trim covers installed on seats equipped with side air bags cannot be repaired, they are to be replaced (cleaning is permissible).**

   ⚠ CAUTION: When removing the seat backrest trim panel, be careful not to damage the J-hooks. If the seat backrest trim panel J-hooks are damaged, install a new seat backrest trim panel.

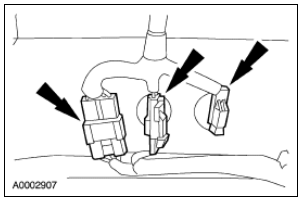
   ⚠ CAUTION: When removing the seat backrest trim panel, be careful not to damage the pin-type retainers. Pulling towards you, use a smooth, controlled force to release the pin-type retainers.

   Remove the seat backrest trim panel.

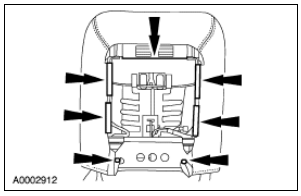
   1. Pull and release the pin-type retainers at the bottom of the seat backrest trim panel.
   2. While holding the seat backrest trim panel at the bottom, push in on the left side of the panel at the lip of the map pocket and slide it to the right to disengage the J-hook. Repeat this process for the right side J-hook but slide the panel to the left to disengage the J-hook.
   3. While pushing in at the top of the seat backrest trim panel, slide it down to disengage the top J-hooks.
   4. Remove the seat backrest trim panel and inspect the J-hooks and pin-type retainers for damage. Discard any damaged retainers and install new.



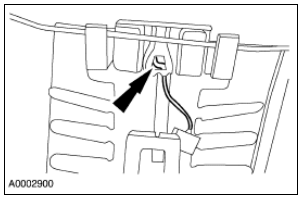
3. Disconnect the electrical connectors.
   - Release the electrical connector locators.



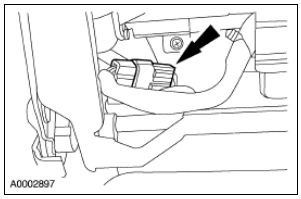
4. Release the J-retainers and pin-type retainers.



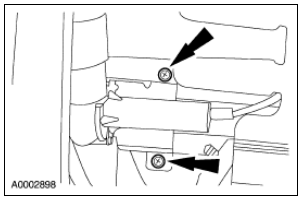
5. Remove the retaining hook.



6. Disconnect the lumbar motor electrical connector.



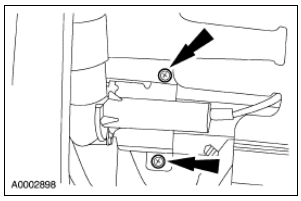
7. Remove the screws and the front seat lumbar motor.



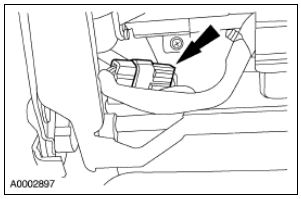
Installation

⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings and notes at the beginning of the removal procedure.

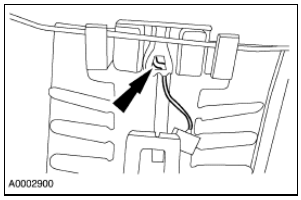
1. Install the front seat lumbar motor and the screws.



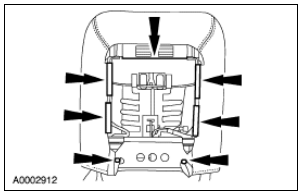
2. Connect the lumbar motor electrical connector.



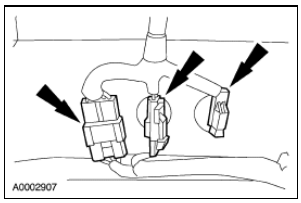
3. Install the retaining hook.



4. Install the J-retainers and pin-type retainers.



5. Connect the electrical connectors.
   - Install the electrical connector locators.

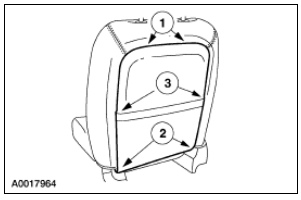


6. ⚠ **CAUTION: Inspect the seat backrest trim panel J-hooks for damage. If damaged, install a new seat backrest trim panel.**

   NOTE: If re-installing the original seat backrest trim panel, install new pin-type retainers.

   Install the seat backrest trim panel.

   1. Angle the top of the seat backrest trim panel inward and up to engage the upper J-hooks to the seat backrest frame.
   2. While holding the seat backrest trim panel up, align the new pin-type retainers at the bottom of the seat backrest trim panel and install them into the seat backrest frame.
   3. With the palm of your hand, install the J-clips by pushing down on the seat backrest trim panel and towards the center of the seat.
      - ♦ Check the retention of the seat backrest trim panel by lightly pulling on the bottom, sides, and top where the retainers are located.



7. Restore the vehicle to operating condition.
   1. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the seat removal and installation procedure.**

      Install the affected seat. For additional information, refer to Front Seat in this section.
   2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation and reactivation procedure.**

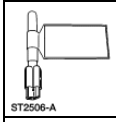
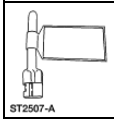
Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

3. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .
4. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Front Seat Cushion

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Disassembly

⚠ WARNING: Always wear safety glasses when repairing a air bag supplemental restraint system (SRS) vehicle and when handling an airbag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

NOTE: The left side is shown, the right side is similar.

NOTE: If a side air bag deployment took place the seatback pad, trim cover, and side air bag module must be replaced. The seatback frame should be replaced if necessary.

All seats

1. Prepare the vehicle for front seat cushion disassembly.
    1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

       Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

       The side air bag sensors are located at or near the base of the B-pillar.

       To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation and reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
3. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

   Remove the affected seat. For additional information, refer to Front Seat in this section.

2. ⚠ **WARNING: Front seat back trim covers installed on seats equipped with side air bags cannot be repaired, they are to be replaced (cleaning is permissible).**

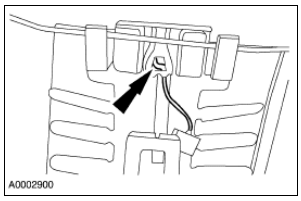
   ⚠ **CAUTION: When removing the seat backrest trim panel, be careful not to damage the J-hooks. If the seat backrest trim panel J-hooks are damaged, install a new seat backrest trim panel.**

   ⚠ **CAUTION: When removing the seat backrest trim panel, be careful not to damage the pin-type retainers. Pulling towards you, use a smooth, controlled force to release the pin-type retainers.**

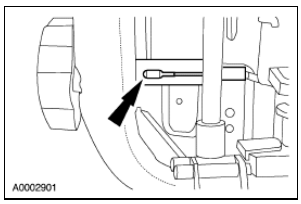
   Remove the seat backrest trim panel.

Seats with manual lumbar

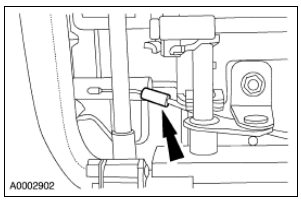
3. Remove the retaining hook.



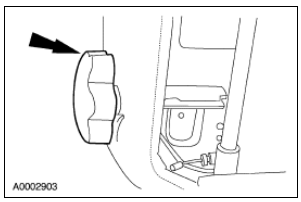
4. Align the end of the adjusting cable in the slot.



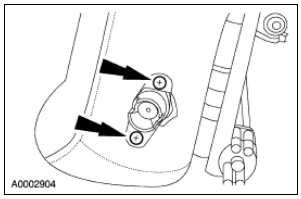
5. Release the adjusting cable.



6. Remove the manual lumbar knob.



7. Remove the manual lumbar screws.



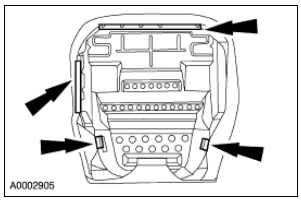
All seats

8. Remove the front cushion side shield. For additional information, refer to Seat - Front Cushion Side Shield in this section.

9. Remove the seat track. For additional information, refer to Seat Track in this section.

10. Remove the seat regulator control switch. For additional information, refer to Seat Control Switch in this section.

11. Release the J-hooks and seat cushion trim cover.

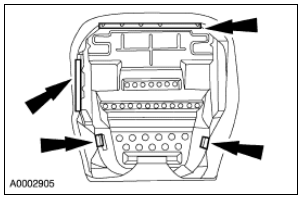


Assembly

⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

All seats

1. Install the J-hooks and the seat trim cover.



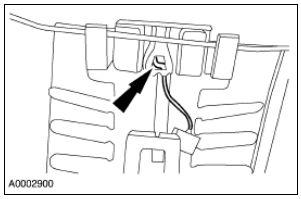
2. Install the front cushion side shield. For additional information, refer to Seat - Front Cushion Side Shield in this section.

3. Install the seat track. For additional information, refer to Seat Track in this section.

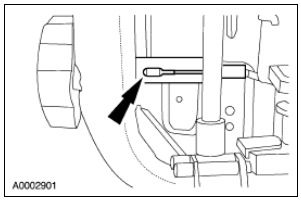
4. Install the seat regulator control switch. For additional information, refer to Seat Control Switch in this section.

Seats with manual lumbar

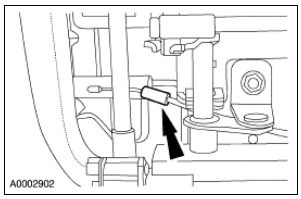
5. Install the retaining hook.



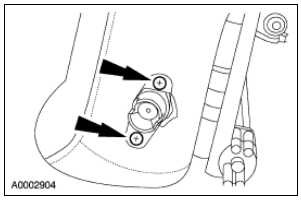
6. Align the end of the adjusting cable in the slot.



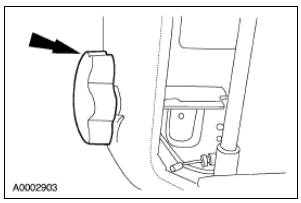
7. Install the adjusting cable.



8. Install the manual lumbar screws.



9. Install the manual lumbar knob.



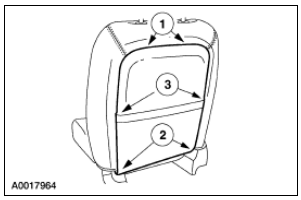
All seats

10. ⚠ **CAUTION: Inspect the seat back trim panel J-hooks for damage. If damaged, install a new seat back trim panel.**

    NOTE: If re-installing the original seat backrest trim panel, install new pin-type retainers.

Install the seat backrest trim panel.

1. Angle the top of the seat backrest trim panel inward and up to engage the upper J-hooks to the seat backrest frame.
2. While holding the seat backrest trim panel up, align the pin-type retainers at the bottom of the seat backrest trim panel and install them into the seat backrest frame.
3. With the palm of your hand, install the J-clips by pushing down on the seat backrest trim panel and towards the center of the seat.
    - Check the retention of the seat backrest trim panel by lightly pulling on the bottom, sides, and top where the retainers are located.



11. Restore the vehicle to operating condition.
    1. **⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the seat removal and installation procedure.**

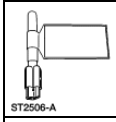
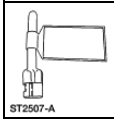
       Install the affected seat. For additional information, refer to Front Seat in this section.
    2. **⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation and reactivation procedure.**

       Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
    3. **⚠ WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

       With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .
    4. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Front Seat Backrest

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Disassembly

⚠ WARNING: Always wear safety glasses when repairing a air bag supplemental restraint system (SRS) vehicle and when handling an airbag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

NOTE: If a side air bag deployment took place the seatback pad, trim cover, and side air bag module must be replaced. The seatback frame should be replaced if necessary.

NOTE: The left side is shown, the right side is similar.

1. Prepare the vehicle for front seat backrest removal.
    1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

       Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

       The side air bag sensors are located at or near the base of the B-pillar.

       To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

       Disconnect the battery ground cable (14301) and wait at least one minute. For additional

information, refer to Section 414-01 .

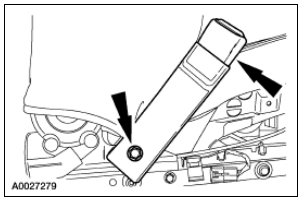
2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation and reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
3. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

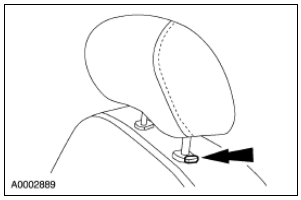
   Remove the affected seat. For additional information, refer to Front Seat in this section.
4. Remove the seat backrest. For more information, refer to Front Seat Backrest in this section.

2. Remove the front cushion side shield trim panel. For additional information, refer to Seat Front Cushion Side Shield in this section.

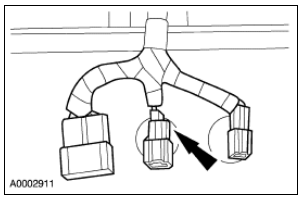
3. Remove the bolt and the safety belt buckle.



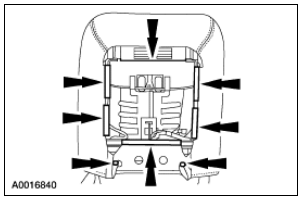
4. Remove the headrest.



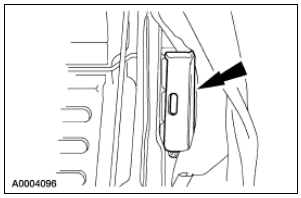
5. Release the electrical connector locators.



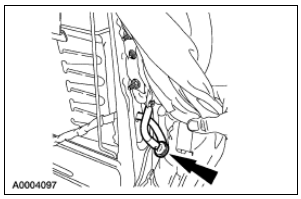
6. Release the J-retainers and pin-type retainers.



7. Reposition the seat backrest trim cover and pad and remove the side air bag module retaining nut cover.

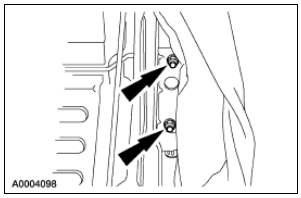


8. Push the wire harness and grommet through the seat backrest frame.

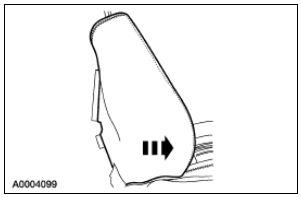


9. **NOTE:** If installing a new side air bag module, use new retaining nuts. If the same side air bag module is to be reused then reuse the side air bag module nuts.

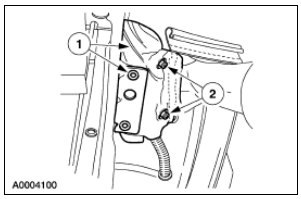
   Remove the side air bag nuts. For additional information, refer to Section 501-20B .



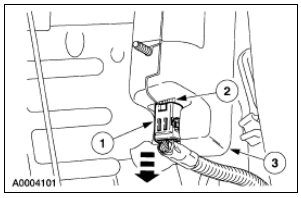
10. With one hand on the side air bag module, position the seat backrest trim cover and pad forward enough to access the side air bag module.



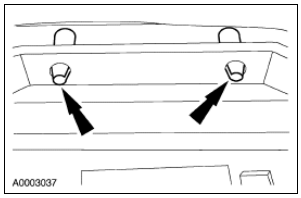
11. Remove the side air bag module from the deployment chute.
    1. Separate the side air bag module and deployment chute from the seat backrest mounting bracket.
    2. Pull the side air bag module mounting studs back through the deployment chute openings and remove the side air bag module from the deployment chute.



12. Disconnect and remove the side air bag module.
    1. Slide the side air bag electrical connector locking clip to disengage it.
    2. Release the two connector tabs (one shown) by pushing in on them and disconnect the side air bag module.
    3. Remove the side air bag module.



13. Pull back the cover to remove the headrest retaining clip.

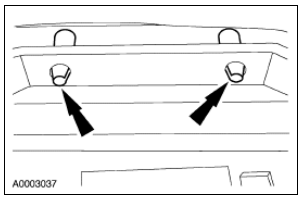


14. Remove the seat backrest cover from the frame.

Assembly

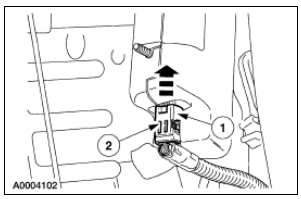
⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the removal procedure.

1. Position the seat backrest cover and install the headrest guides.



2. Install the seat backrest cover onto the frame.

3. Connect the side air bag module electrical connector.
    1. Install the connector to the side air bag module.
    2. Slide the side air bag module electrical connector locking clip to secure he connector to the side air bag module.



4. Make sure the electrical connector is securely fastened to the side air bag module.

⚠ WARNING: Inspect the mounting surfaces of the side air bag module for any foreign objects before installing the side air bag module. If any foreign objects are found, remove them. Failure to do so may result in personal injury in the event of an air bag deployment.

⚠ WARNING: Inspect the side air bag deployment chute and the side air bag cavity in the seat back pad for any foreign objects. If any foreign objects are found, remove them. Failure to do so may result in personal injury in the event of an air bag deployment.

⚠ WARNING: Before installing the side air bag module into the deployment chute, check it for damage and foreign objects. If the air bag module is damaged, replace it. If any foreign objects are found, remove them. Failure to do so may result in personal injury in the event of an air bag deployment.

⚠ WARNING: If the air bag cover has separated or the air bag material has been exposed, install a new side air bag module. Do not attempt to repair the air bag module. Failure to do so may result in personal injury in the event of an air bag deployment.

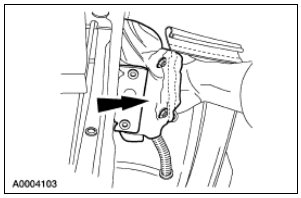
⚠ WARNING: Check the side air bag deployment chute for damage. The deployment chute must not be repaired. If there is any damage to the deployment chute, the seat back trim cover and deployment chute must be installed new as a unit.

⚠ WARNING: If the air bag deployment chute is not properly positioned, the side air bag may not deploy properly.

5. **NOTE:** The alignment pin will only allow the side air bag module to be installed to the seat backrest mounting bracket one way.

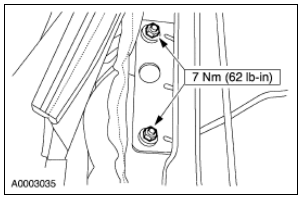
   Position the side air bag module into the deployment chute.

   - Position the side air bag module into the deployment chute with the alignment pin offset to the top and the electrical connector to the bottom of the seat backrest. This will position the alignment pin correctly when the side air bag module and deployment chute are mounted to the seat backrest frame mounting bracket.
   - The side air bag module mounting studs must come through the deployment chute stud openings.

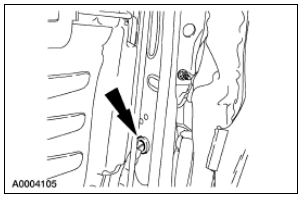


6. **⚠ WARNING: Inspect the mounting surfaces of the deployment chute and the seat back frame mounting bracket for any foreign objects before installing the side air bag module/deployment chute assembly. If any foreign objects are found, remove them. Failure to do so may result in personal injury in the event of an air bag deployment.**

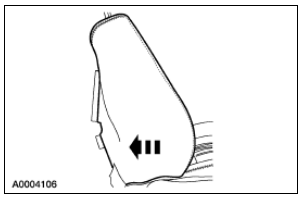
   Install the new side air bag module retaining nuts and tighten to specification.



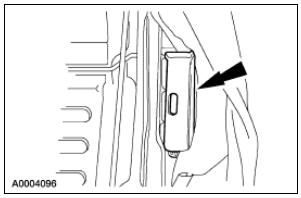
7. Pull the wire harness back through the hole in the seat backrest frame and seat the grommet.



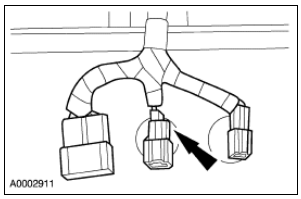
8. Reposition the seat backrest pad and trim cover to the seat backrest frame.



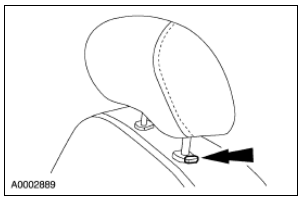
9. Attach the side air bag retaining nut cover.
    - Check that all three attaching clips on the side air bag nuts cover are correctly installed around the side air bag mounting bracket.



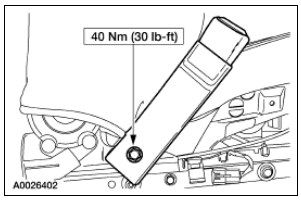
10. Install the electrical connector locators.



11. Install the headrest.



12. Position the front seat safety belt buckle. Install the bolt.



13. Install the front cushion side shield trim panel. For additional information, refer to Seat - Front Cushion Side Shield in this section.

14. Restore the vehicle to operating condition.

1. Install the seat backrest. For additional information, refer to Front Seat Backrest in this section.
2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the seat removal and installation procedure.**

   Install the affected seat. For additional information, refer to Front Seat in this section.
3. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation and reactivation procedure.**

   Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
4. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .
5. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

WINDOW REGULATOR ELECTRIC DRIVE CURRENT DRAW

Description	Specification
No load	5 amperes or less at 12.8 volts

Lubricants

Item	Specification
Urethane Glass Prep Essex U-401	WSB-M2G314-B
Urethane Glass Primer Essex U-402	WSB-M5B280-C
Urethane Metal Primer Essex U-413	WSB-M2G234-C
Urethane Adhesive 400-HV	WSB-M2G316-B
Urethane Adhesive Essex U-216	WSB-M2G316-B
Rear Window Defroster Repair D8AZ-19562-AA or equivalent	WSB-M4J58-B
Dark Walnut Metallic Acrylic Lacquer Touch Up Paint ALBZ-19500-5858A or equivalent	ESR-M2-P100-C

Torque Specifications

Description	Nm	lb-ft	lb-in
Anti-theft shield screw	10		89
Door lock cylinder nut	10		89
Front door window regulator assembly bolts	5		44
Front door inner support bolts	12	9	
Front window regulator to glass bolts	12	9	
Inner front door support bracket nuts	12	9	
Latch screws	13	10	
Window motor screws	3		27
Rear door inner support bolts	12	9	
Rear door window regulator bolts and nuts	5		44

Glass, Frames and Mechanisms

The glass, frames and mechanisms include:

- front door window motor
- rear door window motor
- master window regulator control switch
- back window glass
- front door window glass
- rear door window glass
- rear quarter window glass
- front door window regulator
- rear door window regulator
- windshield glass

Window, One-Touch Down

The driver window one-touch down feature is activated by pressing the master window regulator control switch to the second down position. This allows the front door window glass to move downward until it is fully lowered. Momentarily pressing the window regulator control switch while the window is moving downward will stop the front door window glass.

Window Glass, Door

The bottom of the door window glass is mounted on a slider bracket which is part of the door window regulator. Door window glass bracket spacers provide attachment points for the door window glass and prevent direct contact between the slider bracket and the door window glass.

Switch, Window Regulator Control

Power windows are standard in the LS series. The master window regulator control switch can be used to power any or all of the power windows. A single window regulator control is located on all passenger door armrests to activate the individual power window only.

Motor, Window Regulator

The front and rear window regulator motors are replaced separately.

Glass, Frames and Mechanisms

Refer to Wiring Diagrams Cell 100 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool
 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Principles of Operation

Front Electronics Module (FEM) and Rear Electronics Module (REM)

The front electronics module (FEM) receives inputs and delivers outputs to a majority of the electronically controlled features which reside primarily in the front section of the vehicle. The rear electronics module (REM) receives inputs and delivers outputs to a majority of the electronically controlled features which reside primarily in the rear section of the vehicle. The FEM and REM are configurable modules and must be correctly configured to the vehicle. The modules may also be configured to allow additional features or functions to be added to the vehicle. The FEM and REM do not have any optional window control configurations.

Driver Door Module (DDM)

The DDM receives inputs from the remote keyless entry transmitter and hardwired components such as the master window regulator control switch and delivers outputs in the form of SCP network messages and hardwired component control. The DDM is a configurable module and must be correctly configured to the vehicle. The DDM may also be configured to allow additional features or functions to be added to the vehicle. The only DDM window feature that can be optionally configured is the window global open and close feature.

Module Inputs and Outputs

This system is unique in that many of the inputs that the FEM, REM and DDM receive are over the SCP communication network. These input messages come from other modules connected to the network. The FEM, REM and DDM will interpret the inputs, and in turn command the correct output that was requested. The modules also receive inputs which come directly from components which are hardwired to the modules such as the window regulator control switches.

One type of output the modules provide is over the SCP communication network in the form of messages. These types of outputs are usually generated from a module monitoring a hardwired input and sending a status message to another module. These outputs are commonly required by other modules to carry out their

functions. The second type of output is the control of a component directly hardwired to the module.

Master Window Regulator Control Switch

The master window regulator control switch is hardwired to the DDM. Activating the master window regulator control switch sends a voltage signal to the DDM. The DDM will interpret the signal and control the power and ground to the driver front window regulator electric drive.

Activation of any of the passenger window switches on the master window regulator control switch sends a voltage signal to the DDM. The DDM interprets the signal and sends out the appropriate message over the SCP communication network. For the passenger front window, the FEM will interpret the DDM message and control the passenger front window regulator electric drive. For the rear passenger windows, the REM will interpret the DDM message and control the appropriate rear window regulator electric drive.

The driver one-touch down feature allows the driver front window to be lowered without holding the master window regulator control switch. Activation of the master window regulator control switch to the second down position sends a separate voltage signal to the DDM. The DDM will then control the power and ground to the driver front window regulator electric drive until a switch input is received or the motor reaches a stalled condition.

Passenger Window Power Supply

The REM controls the power supply to all three remote window regulator control switches. To protect the REM from a potential failure, the REM will remove power from the common passenger window power supply when a short to ground is sensed in any remote window regulator control switch, associated circuitry or the power output circuit of the REM. Power will be restored to the power output circuit upon a cycling of the ignition switch. If the REM output circuit is shorted to ground, the REM will immediately remove power from the common power supply circuit. If any remote window regulator control switch or its associated circuits are shorted to ground, the power will remain on the REM output circuit until the switch or circuit containing the short to ground is activated.

Passenger Window Lock-Out

The master window regulator control switch incorporates a passenger window lock-out switch. Activating the passenger window lock-out switch sends a separate voltage signal to the DDM. The DDM will then output a message to the REM. The REM will in turn remove power from the common passenger window power supply circuit. The rear window operation will be allowed from the master window regulator control switch only.

Passenger Front Power Window

The passenger front power window is controlled by the FEM. The passenger front window regulator control switch is hardwired directly to the FEM. Activating the passenger front window regulator control switch sends a voltage input to the FEM. The FEM then controls power and ground to the passenger front power window regulator electric drive, which is directly hardwired to the FEM. The voltage signal will only be received if the REM is supplying voltage to the remote window regulator control switch circuit.

The passenger front window can also be controlled by the master window regulator control switch. Activating the passenger front switch on the master window regulator control switch sends a voltage input to the DDM. The DDM will then send a message to the FEM over the network. The FEM then controls power and ground to the passenger front window regulator electric drive.

Left Rear (LR) and Right Rear (RR) Power Windows

The LR and RR power windows are controlled by the REM. Operating commands for the rear power windows are received in two forms, from the master window regulator control switch over the SCP communication network from the DDM, or directly from the LR or RR window regulator control switches, which are hardwired to the REM.

Activating the LR or RR switch on the master window regulator control switch causes the DDM to send a message to the REM over the SCP communication network. The REM will then control power and ground to the appropriate window regulator electric drive to raise or lower the window.

Activating either the LR or RR window regulator control switch sends a voltage signal to the REM. The REM will then control power and ground to the appropriate window regulator electric drive to raise or lower the window. A voltage signal will only be received if the window lock-out is OFF and the REM is supplying voltage to the remote window regulator control switch power circuit.

Rear Window Defrost

The rear window defrost feature is controlled by the REM, powertrain control module (PCM), and the dual automatic temperature control (DATC) module. The rear window defrost switch is incorporated in the climate control head. When the switch is selected ON, the DATC module will send a message over the SCP communication network to the REM. The REM will then check its other messages for vehicle rpm from the PCM. If the rpm message is received, the REM will then ground the rear window defrost relay coil control circuit which is hardwired to the REM. The ground signal closes the rear window defrost relay which applies power to the rear window grid through the antenna isolator module. Fault management of the rear window defrost feature will prevent the rear window defrost from operating when a rpm or ignition switch invalid/missing data message is received.

Diagnosis

The FEM, REM and DDM constantly monitor systems under their control and report a concern in the form of a diagnostic trouble code (DTC). DTCs can be retrieved with the diagnostic tool or an equivalent tester through the SCP communication network.

This vehicle's design makes it unique in that electronic functions are divided into zones. The DDM controls features near the driver front door. The FEM controls features in the front portion of the vehicle and the REM controls the features in the rear portion. These systems rely heavily on the SCP communication network in order to transmit and receive messages. It is vital when diagnosing this vehicle's electronic systems, to understand:

- where the input (command) originates.
- all input information messages necessary in order for a feature to operate correctly.
- which module(s) receive(s) the input (or command message).
- if the module which received the input (message) controls the output of the feature, or does it output a message over the communication network to another module.
- which module controls the output of the feature.

Delayed Accessory

Delayed accessory operation allows the power windows, radio and moon roof (if equipped) to operate for up

to ten minutes after the ignition is turned to OFF. The delayed accessory function is controlled by the DDM. When the ignition switch is turned from RUN to OFF, the DDM will begin the timing sequence. If a door is opened or the ignition switch is activated to another position, the DDM will cancel the delayed accessory operation.

Heated Wiper Park

The heated wiper park grid (located within the lower painted area of the windshield) receives power from the heated wiper park relay located in the underhood auxiliary junction box (AJB). The heated wiper park relay coil is connected to a fused circuit from the underhood AJB. The heated wiper park relay is controlled by a switched ground from the DATC module controlled heated wiper park ON/OFF switch. The heated wiper park grid is automatically activated by the DATC module when ambient air temperature drops below 38° F (3° C), and can be manually activated by pushing the heated wiper park ON/OFF switch. The system can be manually switched OFF, and will shut off automatically when ambient air temperature rises above 38° F (3° C) or if the vehicle voltage is low.

Inspection and Verification

NOTE: The DATC module, DDM, FEM, and REM must be reconfigured upon replacement. For more information refer to Section 418-01 .

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical or electrical damage.

   Visual Inspection Chart

Mechanical	Electrical
• Window regulator • Window run weatherstrip • Door window glass	• Battery junction box (BJB) fuse(s): 409 (5A), 419 (30A), 420 (20A), 422 (30A), 425 (40A), 426 (30A), 427 (30A), 429 (30A), and 430 (20A) • Central junction box (CJB) fuse 207 (5A) • Underhood auxiliary junction box (AJB) fuse 113 (30A) • Master window regulator control switch • Remote window regulator control switch • Window regulator electric drive • DATC module • DDM • FEM • REM • Rear window defrost grid • Heated wiper park grid • Circuitry

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the diagnostic tool does not power up, refer to the diagnostic tool manual.
5. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:
   - CKT 914, CKT 915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for FEM, Go To Pinpoint Test A .

- NO RESP/NOT EQUIP for REM, Go To Pinpoint Test B .
- NO RESP/NOT EQUIP for DDM, Go To Pinpoint Test C .
- NO RESP/NOT EQUIP for DATC module, refer to Section 412-00 .
- SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), clear the continuous DTCs and carry out self-test diagnostics for the FEM, REM, DDM, and DATC module.

6. If DTCs related to the DATC module are retrieved, refer to Section 412-00 .

7. If the DTCs retrieved are related to the concern, go to the FEM Diagnostic Trouble Code (DTC) Index, REM Diagnostic Trouble Code (DTC) Index, or DDM Diagnostic Trouble Code (DTC) Index.

8. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue the diagnostics.

FEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1319	Driver Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1327	Passenger Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1342	ECU Is Defective	FEM	CLEAR the DTC. REPEAT the FEM self-test. If DTC B1342 is retrieved, INSTALL a new FEM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test.
B1438	Wiper Mode Select Switch Circuit Failure	FEM	REFER to Section 501-16 .
B1446	Wiper Park Sense Circuit Failure	FEM	REFER to Section 501-16 .
B1479	Wiper Washer Fluid Level Sensor Circuit Failure	FEM	REFER to Section 413-01 .
B1499	Lamp Turn Signal Left Circuit Failure	FEM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1503	Lamp Turn Signal Right Circuit Failure	FEM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1519	Hood Switch Circuit Failure	FEM	REFER to Section 419-01A .
B1567	Lamp Headlamp High-Beam Circuit Failure	FEM	REFER to Section 417-01 .
B1676	Battery Pack Voltage Out of Range	FEM	REFER to Section 414-00 .
B1794	Lamp Headlamp Low-Beam Circuit Failure	FEM	REFER to Section 417-01 .
B2214	Window Passenger Front Up Switch Short to Battery	FEM	Go To Pinpoint Test G .

B2215	Window Passenger Front Down Switch Short to Battery	FEM	Go To Pinpoint Test G .
B2312	Mirror Passenger Horizontal Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2316	Mirror Passenger Vertical Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2477	Module Configuration Failure	FEM	REFER to Section 418-01 .
C1284	Oil Pressure Switch Failure	FEM	REFER to Section 413-01 .
C1446	Brake Switch Circuit Failure	FEM	REFER to Section 413-01 .
C1924	VAPS Solenoid Actuator Output Circuit Short to Ground	FEM	REFER to Section 211-00 .
C1925	VAPS Solenoid Actuator Return Circuit Failure	FEM	REFER to Section 211-00 .
U1027	SCP (J1850) Invalid or Missing Data for Engine RPM	PCM	CARRY OUT the PCM self-test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test. REFER to Section 206-09A .
U1059	SCP (J1850) Invalid or Missing Data for Transmission / Transaxle / PRNDL	PCM	CARRY OUT the PCM self-test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the ICM self-test. REFER to Section 413-01 .
U1222	SCP (J1850) Invalid or Missing Data for Interior Lamps	ICM	CARRY OUT the ICM self-test. REFER to Section 413-01 .
U1227	SCP (J1850) Invalid or Missing Data for Body Status Request	ICM	CARRY OUT the ICM self-test. REFER to Section 413-01 .

REM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1201	Fuel Sender Circuit Failure	REM	REFER to Section 413-01 .
B1300	Power Door Lock Circuit Failure	REM	REFER to Section 501-14B .
B1310	Power Door Unlock Circuit Failure	REM	REFER to Section 501-14B .
B1331	Decklid Ajar Rear Door Circuit Failure	REM	REFER to Section 417-02 .
B1335	Door Ajar RR Circuit Failure	REM	REFER to Section 417-02 .
B1342	ECU Is Defective	REM	CLEAR the DTC. REPEAT the REM self-test. If DTC B1342 is retrieved, INSTALL a new REM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test.
B1483	Brake Pedal Input Circuit Failure	REM	REFER to Section 417-01 .
B1499	Lamp Turn Signal Left Circuit Failure	REM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	REM	REFER to Section 417-01 .

B1503	Lamp Turn Signal Right Circuit Failure	REM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	REM	REFER to Section 417-01 .
B1551	Decklid Release Circuit Failure	REM	REFER to Section 501-14B .
B1571	Door Ajar LR Circuit Failure	REM	REFER to Section 417-02 .
B1676	Battery Pack Voltage Out of Range	REM	REFER to Section 414-00 .
B2172	Inertia Switch Input Circuit Open	REM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
B2174	Window Driver Rear Remote Up Switch Short to Battery	REM	Go To Pinpoint Test M .
B2178	Window Driver Rear Remote Down Switch Short to Battery	REM	Go To Pinpoint Test M .
B2190	Window Passenger Rear Remote Up Switch Short to Battery	REM	Go To Pinpoint Test J .
B2194	Window Passenger Rear Remote Down Switch Short to Battery	REM	Go To Pinpoint Test J .
B2477	Module Configuration Failure	REM	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test. REFER to Section 206-09A .
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/ PRNDL	PCM	CARRY OUT the PCM self-test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the ICM self-test. REFER to Section 413-01 .

DDM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1309	Power Door Lock Circuit Short to Ground	DDM	REFER to Section 501-14B .
B1341	Power Door Unlock Circuit Short to Ground	DDM	REFER to Section 501-14B .
B1342	ECU Is Defective	DDM	CLEAR the DTC. REPEAT the DDM self-test. If DTC B1342 is retrieved, INSTALL a new DDM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test.
B1400	Driver Power Window One Touch Window Relay Circuit Short to Battery	DDM	Go To Pinpoint Test Q .
B1405	Driver Power Window Down Circuit Short to Battery	DDM	Go To Pinpoint Test F .
B1408	Driver Power Window Up Circuit Short to Battery	DDM	Go To Pinpoint Test F .
B1416	Power Window LR Motor Circuit Short to Battery	DDM	Go To Pinpoint Test N .
B1420	Passenger Power Window Motor Circuit Short to Battery	DDM	Go To Pinpoint Test H .

B1424	Power Window RR Motor Circuit Short to Battery	DDM	Go To Pinpoint Test K .
B1530	Memory Set Switch Circuit Short to Ground	DDM	REFER to Section 501-09 .
B1534	Memory 1 Switch Circuit Short to Ground	DDM	REFER to Section 501-09 .
B1538	Memory 2 Switch Circuit Short to Ground	DDM	REFER to Section 501-09 .
B1676	Battery Pack Voltage Out of Range	DDM	REFER to Section 419-10 .
B2112	Door Driver Set Switch Stuck Failure	DDM	REFER to Section 501-14B .
B2116	Door Driver Reset Switch Stuck Failure	DDM	REFER to Section 501-14B .
B2320	Mirror Driver Horizontal Feedback Potentiometer Circuit Failure	DDM	REFER to Section 501-09 .
B2324	Mirror Driver Vertical Feedback Potentiometer Circuit Failure	DDM	REFER to Section 501-09 .
B2336	Mirror Switch Assembly Circuit Failure	DDM	REFER to Section 501-09 .
B2425	Remote Keyless Entry Out of Synchronization	DDM	REFER to Section 501-14B .
B2477	Module Configuration Failure	DDM	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test. REFER to Section 206-09A .
U1059	SCP (J1850) Invalid or Missing Data for Transmission / Transaxle / PRNDL	PCM	CARRY OUT the PCM self-test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE FRONT ELECTRONIC MODULE (FEM)

PINPOINT TEST B: NO COMMUNICATION WITH THE REAR ELECTRONIC MODULE (REM)

PINPOINT TEST C: NO COMMUNICATION WITH THE DRIVER DOOR MODULE (DDM)

PINPOINT TEST D: ALL POWER WINDOWS ARE INOPERATIVE FROM THE MASTER WINDOW REGULATOR CONTROL SWITCH ONLY

PINPOINT TEST E: ALL PASSENGER POWER WINDOWS ARE INOPERATIVE FROM THE REMOTE WINDOW REGULATOR CONTROL SWITCHES

PINPOINT TEST F: A SINGLE POWER WINDOW IS INOPERATIVE DRIVER WINDOW FROM THE MASTER WINDOW REGULATOR CONTROL SWITCH

PINPOINT TEST G: A SINGLE POWER WINDOW IS INOPERATIVE PASSENGER FRONT FROM MASTER AND PASSENGER FRONT WINDOW REGULATOR CONTROL SWITCHES

PINPOINT TEST H: A SINGLE POWER WINDOW IS INOPERATIVE PASSENGER FRONT FROM THE MASTER WINDOW REGULATOR CONTROL SWITCH ONLY

PINPOINT TEST I: A SINGLE POWER WINDOW IS INOPERATIVE PASSENGER FRONT FROM THE PASSENGER FRONT WINDOW REGULATOR CONTROL SWITCH ONLY

PINPOINT TEST J: A SINGLE POWER WINDOW IS INOPERATIVE RIGHT REAR FROM MASTER AND REMOTE WINDOW REGULATOR CONTROL SWITCHES

PINPOINT TEST K: A SINGLE POWER WINDOW IS INOPERATIVE RIGHT REAR FROM THE MASTER WINDOW REGULATOR CONTROL SWITCH ONLY

PINPOINT TEST L: A SINGLE POWER WINDOW IS INOPERATIVE RIGHT REAR FROM RR WINDOW REGULATOR CONTROL SWITCH ONLY

PINPOINT TEST M: A SINGLE POWER WINDOW IS INOPERATIVE LEFT REAR FROM ALL WINDOW REGULATOR CONTROL SWITCHES

PINPOINT TEST N: A SINGLE POWER WINDOW IS INOPERATIVE LEFT REAR FROM THE MASTER WINDOW REGULATOR CONTROL SWITCH ONLY

PINPOINT TEST O: A SINGLE POWER WINDOW IS INOPERATIVE LEFT REAR FROM THE LR WINDOW REGULATOR CONTROL SWITCH ONLY

PINPOINT TEST P: ALL/SINGLE PASSENGER POWER WINDOWS ARE INOPERATIVE PASSENGER WINDOW LOCK-OUT NOT OPERATING CORRECTLY

PINPOINT TEST Q: THE ONE TOUCH DOWN FEATURE IS INOPERATIVE

PINPOINT TEST R: THE DEFROST SYSTEM IS INOPERATIVE REAR WINDOW DEFROST

PINPOINT TEST S: THE DEFROST SYSTEM IS INOPERATIVE HEATED WIPER PARK

PINPOINT TEST T: THE DEFROST SYSTEM WILL NOT SHUT OFF AUTOMATICALLY REAR WINDOW DEFROST

PINPOINT TEST U: THE DEFROST SYSTEM WILL NOT SHUT OFF AUTOMATICALLY HEATED WIPER PARK

Component Test

Grid Wire Test

1. Using a bright lamp in the vehicle, inspect the wire grid from the exterior. A broken grid wire will appear as a brown spot.

2. Run the engine at idle. Set the rear window defrost switch to ON. The indicator light should come on.

3. Working in the vehicle with a voltmeter, contact the broad red-brown stripes of the rear glass window positive lead to battery side and the negative lead to ground side. The meter should read 10-13 volts. A lower voltage reading indicates a loose ground connection.

4. Contact a good ground point with the negative lead of the meter. The voltage reading should remain the same.

5. With the negative lead of the meter grounded, touch each grid line of the rear window defrost glass (42006) at its midpoint with the positive lead. A reading of approximately six volts indicates that the line is good. A reading of zero volts indicates that the line is broken between the midpoint and the B+ side of the grid line. A reading of 12 volts indicates that the circuit is broken between the midpoint of the grid line and ground.

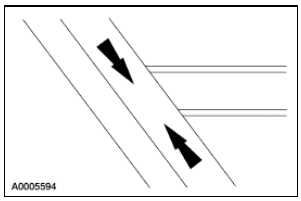
Lead Terminal Repair

Special Tool(s)

 ST1110-A	Heat Gun 107-R0300 or equivalent

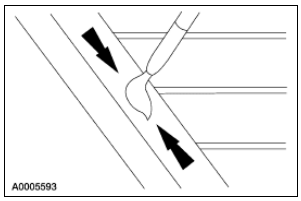
1. **NOTE:** The rear window glass (42006) must be at room temperature at the time of the repair.

   Clean the bus bar in the area to be repaired with steel wool (3/0 to 4/0 grade).



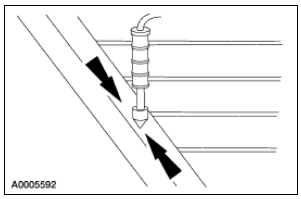
2. **NOTE:** Allow 10 minutes of drying time between the coats.

   Apply three coats of Rear Window Defroster Repair D8AZ-19562-AA or equivalent meeting Ford specification ESB-M4J58-A to the surface.



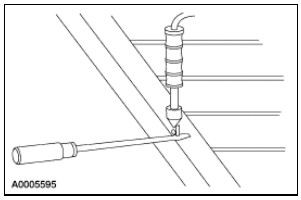
3. ⚠ **CAUTION: Do not overheat the rear window glass or damage to the rear window glass may occur.**

   Tin the bus bar repair area with solder.



4. ⚠ **CAUTION: To prevent overheating the rear window glass, remove the soldering gun as soon as the solder flows.**

   Preheat the rear window glass in the area to be repaired using the special tool and solder the terminal to the bus bar.



5. **NOTE:** Turn the heated back window switch ON for five minutes prior to the final inspection of the repair.

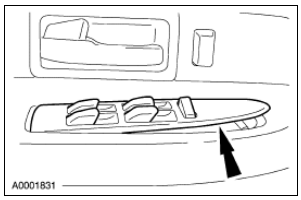
   Apply Rear Window Defroster Repair D8AZ-19562-AA or equivalent meeting Ford specification ESB-M4J58-A to the repair area as needed.

Switch Master Window Regulator Control

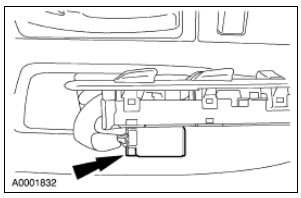
Removal and Installation

1. ⚠ **CAUTION: Carefully lift out the master control regulator switch from the front of the door panel to avoid breaking the tab.**

   Remove the master window control regulator switch.



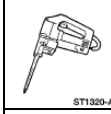
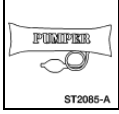
2. Disconnect the electrical connector.



3. To install, reverse the removal procedure.

Window Glass Back

Special Tool(s)

 ST1320-A	Rotunda Interior Auto Glass Cut-Out Knife Kit 164-R2450 or equivalent
 ST1109-A	Rotunda Pneumatic Knife with Offset Blade 107-R1511 or equivalent
 ST2085-A	The Pumper 164-R2459 or equivalent

Removal

⚠ WARNING: To prevent glass splinters from entering the eyes or cutting the hands, wear safety glasses and heavy gloves when cutting the glass from the vehicle.

⚠ CAUTION: Do not scratch the pinch weld.

1. Remove the package tray trim panel. For additional information, refer to Section 501-05 .

2. Disconnect the three back window glass electrical connectors:
   - two rear defrost electrical connectors.
   - FM antenna electrical connector.

3. If equipped, disconnect the cellular phone antenna connector.

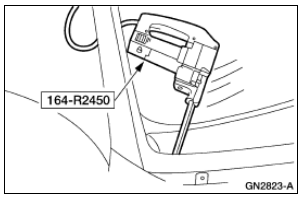
4. Lower the rear portion of the headliner.

5. Using a soft brush or vacuum, remove the dirt and foreign material from the pinch weld.

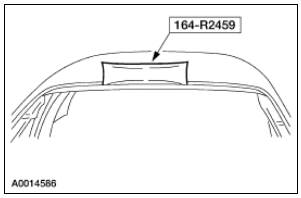
6. **⚠ CAUTION: Care must be taken to avoid scratching the pinch weld.**

   NOTE: Lubricate the existing urethane adhesive with water to aid the special tool while cutting.

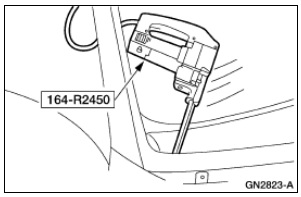
   Using the special tool, starting at the top center of the back window glass, cut the adhesive away from the glass and work down the sides.



7. Using the special tool, distance the back window glass from the body.



8. Using the special tool, cut the remaining urethane adhesive and remove the back window glass.



9. Using a soft brush or vacuum, remove the dirt and foreign material from the pinch weld.

Installation

⚠ CAUTION: After installing the new urethane-installed glass, the vehicle should not be driven until the urethane adhesive has cured. The curing time at temperatures above 13° C (55° F) and relative humidity above 50% is 12-24 hours. (Refer to the Essex drive away chart for the cure times as the temperatures and humidity vary). Inadequate curing of the urethane adhesive may adversely affect the strength of the urethane adhesive bond.

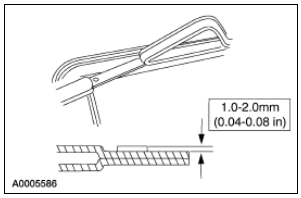
1. Dry fit the replacement back window glass to the existing urethane bed on the body pinch weld. Align the back window glass in the opening for uniform fit.

2. Use tape or non-permanent marking pencil to make alignment marks on the back window glass (preferably at the setting blocks), and the body to aid in the installation alignment of the replacement back window glass.

3. After alignment, remove the back window glass and molding assemblies from the vehicle and place on a stable work surface.

4. **⚠ CAUTION: Care must be taken to avoid scratching the pinch weld.**

   Trim the remaining urethane adhesive on the pinch weld using only the full-cut method. In this method, most of the existing urethane adhesive is removed leaving a level bead around the entire pinch weld.



5. **⚠ WARNING: All rust found on the pinch weld must be removed and the pinch weld restored to OEM specifications. If surface rust is found, remove completely down to clean, bare metal. Prime pinch weld metal with an OEM recommended curing automotive paint primer and allow to cure properly. If rust has penetrated through the pinch weld metal, repair the pinch weld sheet metal at a body shop before proceeding.**

   Check the pinch weld for damaged sheet metal, raised sheet metal at the spot welds, rust or foreign

material that may cause glass breakage. Clean or repair surface as necessary.

6. Use the wool applicator to apply Urethane Metal Primer Essex U-413 meeting Ford specification WSB-M2G234-C to any exposed metal on the pinch weld. Allow six to ten minutes to dry.

7. If reinstalling the original back window glass, remove any excess urethane adhesive.

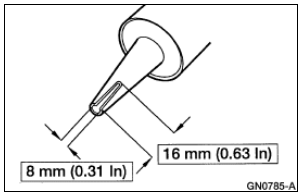
8. Clean the inside of the glass surface with an alcohol-free cleaner to make sure the ceramic-coated area is clean.

9. ⚠ **CAUTION: Wipe off the urethane glass prep immediately after each application because it flash dries. Apply deliberate strokes, making sure not to overlap the applied area.**

   If installing a new back window glass, apply Urethane Glass Prep Essex U-401 meeting Ford specification WSB-M2G314-B twice around the glass surface to be prepped.

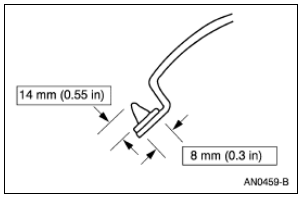
10. If installing a new back window glass, apply Urethane Glass Primer Essex U-402 meeting Ford specification WSB-M5B280-C to the same area that was prepped in the previous step. Allow five minutes to dry.

11. Cut the urethane adhesive applicator tip to specification.



12. ⚠ **CAUTION: If the vehicle is to be driven within 24 hours of urethane adhesive application, Urethane Adhesive Essex U-216 meeting Ford specification WSB-M2G316-B must be used due to its one-hour cure time.**

    Apply a bead of Urethane Adhesive Essex 400-HV or Essex U-216, meeting Ford specification WSB-M2G316-B to the pinch weld.



13. ⚠ **CAUTION: Open the windows to prevent the back window glass from being pushed out by air pressure if a door is closed.**

    Install the back window glass on the pinch weld. Align the back window glass to the body using the alignment marks while pushing downward to set the stops.

14. Inspect the back window glass for air or water leaks and add urethane adhesive where needed.

15. If equipped, install the cellular phone antenna. For additional information, refer to Section 419-05 .

16. Connect the three back window electrical connectors:
    - two rear defroster connectors.
    - FM antenna electrical connector.

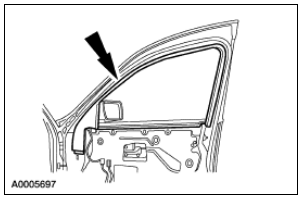
17. Install the package tray trim panel. For additional information, refer to Section 501-05 .

Window Glass Front Door

Removal and Installation

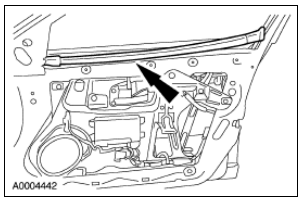
1. Remove the door trim panel. For additional information; refer to Section 501-05 .

2. Remove the interior garnish moulding.

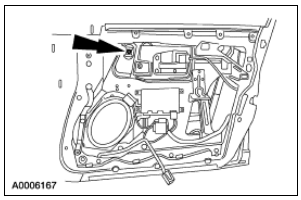


3. Remove the watershield.

4. Remove the interior weatherstrip.

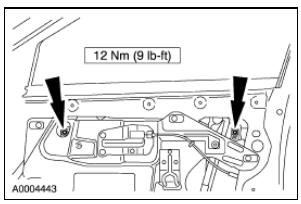


5. Position the forward front window regulator to glass bolt to the bottom of the access hole.



6. **NOTE:** Do not remove the bolts.

   Loosen the front window regulator to glass bolts.



7. Hold the glass in place and lower the window regulator to the bottom of the door panel.

8. Remove the front door window glass.

9. ⚠ **CAUTION: Make sure the front door window glass correctly seats in the glass mounting brackets as the front door window glass is raised.**

   NOTE: Position the front door window glass against the B-pillar.

NOTE: Support the front door window glass and raise the window regulator to the full upright position.

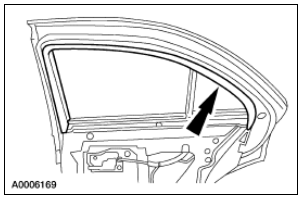
To install, reverse the removal procedure.

Window Glass Rear Door

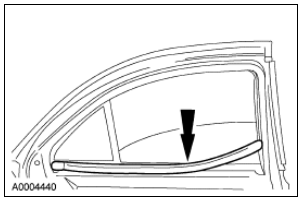
Removal and Installation

1. Remove the rear door trim panel. For additional information, refer to Section 501-05 .

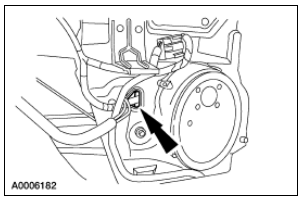
2. Remove the interior garnish molding.



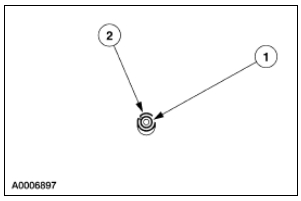
3. Remove the interior weather strip.



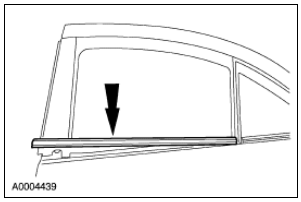
4. Lower the rear door window glass until the glass spacer bracket is visible in the access hole.



5. Remove the rear door window glass spacer bracket.
    1. Using a punch, remove the center portion of the spacer bracket.
    2. Remove the outer portion of the spacer bracket.

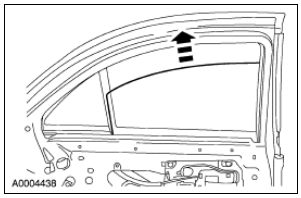


6. Remove the exterior weatherstrip.



7. Remove the rear door window glass.

- Lift the rear door window glass out of the window regulator.
- Lower the rear door window glass out of the channel.
- Lift the rear door window glass through the belt opening to the outside of the channel.



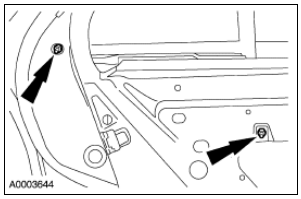
8. **NOTE:** Prior to the installation of the window, reinstall the outer and center portion of the spacer bracket into the rear door window glass. The spacer bracket should protrude equal distances on both sides of the window glass.

   To install, reverse the removal procedure.

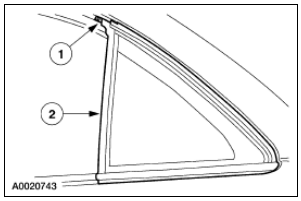
Window Glass Rear Quarter

Removal and Installation

1. Remove the rear door window glass. For additional information, refer to Window Glass Rear Door .
2. Remove the rear door glass run and the exterior moulding at the top of the glass.
3. Remove the quarter window glass nuts.



4. Remove the quarter window glass.
    1. Remove the screw.
    2. Remove the quarter window glass.



5. **NOTE:** If reinstalling the original quarter glass, clean off any remaining butyl prior to installation.

   NOTE: Clean the area of any remaining foam or residue prior to installation of the quarter window glass.

   NOTE: Apply the new butyl to the installation area.

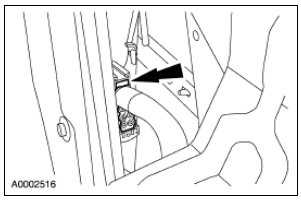
   To install, reverse the removal procedure.

Window Regulator Front Door

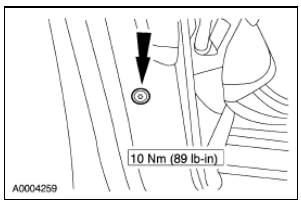
Removal and Installation

1. Remove the front door window glass. For additional information, refer to Window Glass Front Door .

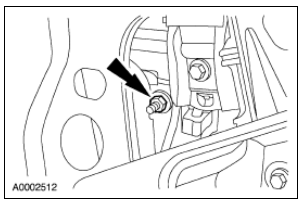
2. Disconnect the door latch electrical connector.



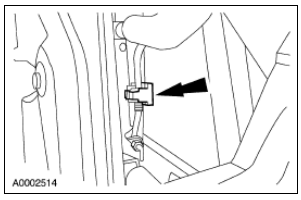
3. Remove the anti-theft shield screw.



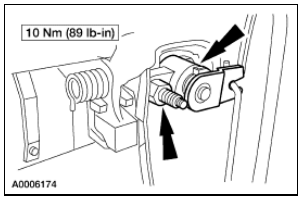
4. Remove the nut and position the anti-theft shield aside.



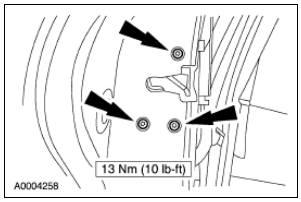
5. Release the clip and disconnect the exterior door handle actuating rod.



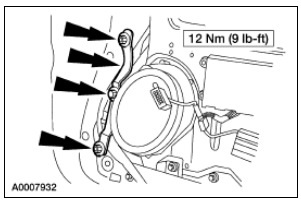
6. Remove the nut and the door lock cylinder (driver door only).



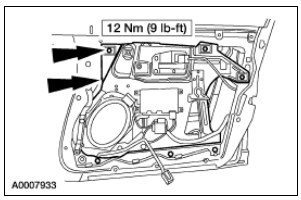
7. Remove the latch screws.



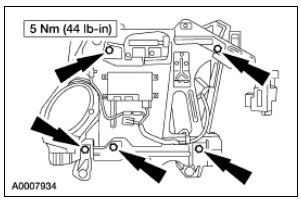
8. Remove the two nuts, the bolt and the inner front door support bracket.



9. Remove the bolts and the front door inner support.



10. Remove the bolts and the window regulator assembly.
    - Disconnect the harness locators and reposition the harness.



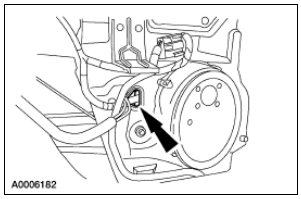
11. To install, reverse the removal procedure.

Window Regulator Rear Door

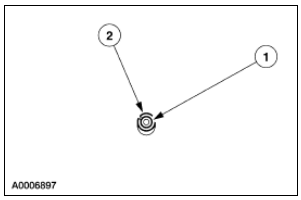
Removal

1. Remove the rear door trim panel. For additional information, refer to Section 501-05 .

2. Lower the rear door window glass until the glass spacer bracket is visible in the access hole.

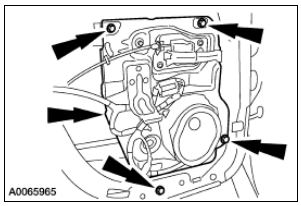


3. Remove the rear door window glass spacer bracket.
    1. Using a punch, remove the center portion of the spacer bracket.
    2. Remove the outer portion of the spacer bracket.

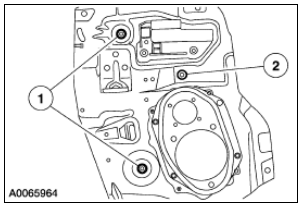


4. Position the rear window glass to the top of the window opening and tape around the door frame to hold in place.

5. Position the inner door module assembly aside.
    1. Remove the bolts.
    2. Position the support aside.



6. Remove the rear door window regulator.
    1. Remove the two nuts.
    2. Remove the bolt.
    3. Remove the rear door window regulator.
        - Disconnect the electrical connector.

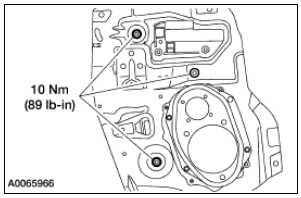


Installation

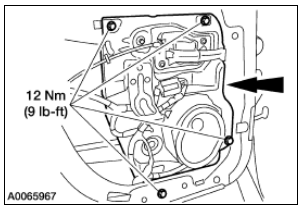
1. **NOTE:** Prior to the attaching the window to the regulator, reinstall the outer and center portions of the spacer bracket into the rear door window glass. The spacer bracket should protrude equal distances on both sides of the window glass.

   Install the spacer bracket into the rear door window glass.

2. Install the rear door window regulator.
   1. Position the window regulator.
   2. Install the two nuts and one bolt.
      - ♦ Connect the electrical connector.



3. Position the inner door module assembly to the door and install the bolts.



4. Operate the rear door window regulator to the full up position until the rear window glass spacer bracket is engaged with the regulator.
   - An audible click should be hear when the spacer bracket is engaged.

5. Install the rear door trim panel. For additional information, refer to Section 501-05.

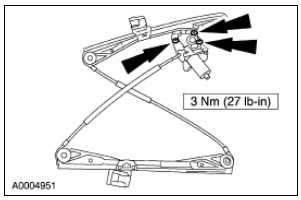
6. Check the rear door window glass for proper operation.

Motor and Window Regulator Front Door

Removal and Installation

1. Remove the front door window regulator. For additional information, refer to Window Regulator Front Door .

2. Remove the screws and the motor from the front door window regulator.



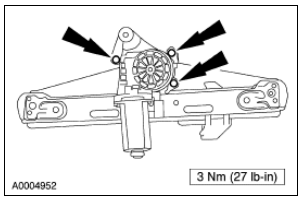
3. To install, reverse the removal procedure.

Motor and Window Regulator Rear Door

Removal and Installation

1. Remove the rear door window regulator. For additional information, refer to Window Regulator Rear Door .

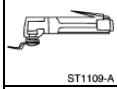
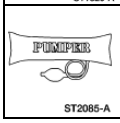
2. Remove the screws and the motor from the rear door window regulator.



3. To install, reverse the removal procedure.

Windshield Glass

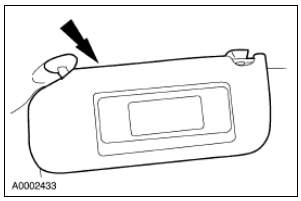
Special Tool(s)

 ST1109-A	Pneumatic Knife with Offset Blade 107-R1511 or equivalent
 ST1320-A	Interior Auto Glass Cut-Out Knife Kit 164-R2450 or equivalent
 ST2085-A	The Pumper 164-R2459 or equivalent

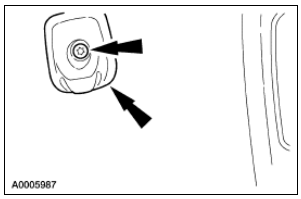
Removal

⚠ WARNING: To prevent glass splinters from entering the eyes or cutting the hands, wear safety glasses and heavy gloves when cutting the glass from the vehicle.

1. Remove the cowl vent screen. For additional information, refer to Section 501-02 .
2. Remove the interior rear view mirror. For additional information, refer to Section 501-09 .
3. Remove the rain sensor module (if equipped). For additional information, refer to Section 501-16 .
4. Remove the screws and the sun visors.
   - Disconnect the electrical connectors.



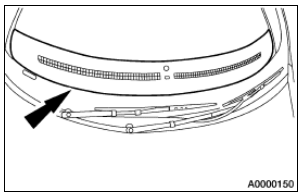
5. Remove the screws and the sun visor clips.



6. Remove the LH and RH windshield side garnish mouldings. For additional information, refer to Section 501-05 .
7. Partially remove the front door weatherstrip.
8. Partially drop the headliner near the windshield glass opening and block with suitable material.

9. Disconnect the two heated wiper park grid electrical connectors.

10. Remove the instrument panel defroster opening grille assembly.
    - Disconnect the electrical connectors.



11. Remove the eight screws and the windshield drip mouldings.

12. Using a soft brush or vacuum, remove dirt and foreign material from the pinch weld.

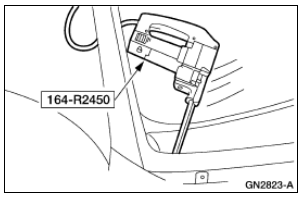
13. **⚠ CAUTION: Cover the instrument panel in order to prevent possible damage.**

    ⚠ CAUTION: Care must be used to avoid scratching the pinch weld.

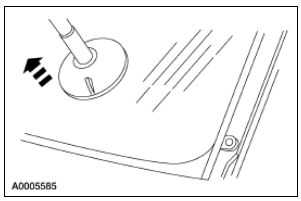
    NOTE: Lubricate the existing urethane adhesive with water to aid the special tool while cutting.

    NOTE: When cutting foam inside, first cut foam dam to access urethane adhesive.

    Using the special tool, starting at the top center of the windshield glass, cut the urethane adhesive away from the glass and work down the sides.



14. Remove the windshield glass and mouldings assembly using a suitable suction tool.



15. Remove the dual lock windshield glass stops from the sheet metal frame.

16. Using a soft brush or vacuum, remove dirt and foreign material from the pinch weld.

Installation

⚠ CAUTION: After installing the new urethane-installed glass, the vehicle should not be driven until the urethane adhesive has cured. The curing time at temperatures above 13° C (55° F) and relative humidity above 50% is 12-24 hours. (Refer to the Essex drive away chart for the cure times as the temperatures and humidity vary). Inadequate curing of the urethane adhesive may adversely affect the strength of the urethane adhesive bond.

1. Dry fit the replacement windshield glass to the existing urethane bed on the body pinch weld. Align

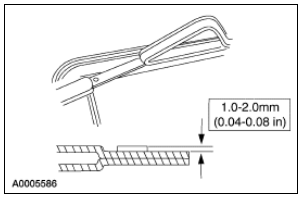
the windshield in the opening for uniform fit and adjust setting blocks as needed for best fit.

2. Use tape or non-permanent marking pencil to make alignment marks on the windshield (preferably at the setting blocks), and the body to aid in the installation alignment of the replacement windshield.

3. After alignment, remove the windshield glass and moulding assemblies from the vehicle and place on a stable work surface.

4. ⚠ **CAUTION: Care must be taken to avoid scratching the pinch weld.**

   Trim the remaining urethane adhesive on the pinch weld. The urethane must be smooth and free of cuts and contamination after trimming. Avoid touching the urethane surface after preparation.



5. ⚠ **CAUTION: All rust found on the pinch weld must be removed and the pinch weld restored to OEM specifications. If surface rust is found, remove completely down to clean, bare metal. Prime pinch weld metal with an OEM recommended curing automotive paint primer and allow to cure properly. If rust has penetrated through the pinch weld metal, repair the pinch weld sheet metal at a body shop before proceeding.**

   Check the pinch weld for damaged sheet metal, raised sheet metal at the spot welds, rust or foreign material that may cause glass breakage. Clean or repair surface as necessary.

6. Use the wool applicator to apply Urethane Metal Primer Essex U-413 meeting Ford specification WSB-M2G234-C to any exposed metal on the pinch weld. Allow six to ten minutes to dry.

7. If re-installing the same windshield glass that was removed, trim the remaining urethane adhesive from the windshield surface, leaving a thin layer for adhering to the new urethane bead.

8. Clean the inside of the glass surface with an alcohol-free cleaner to make sure the ceramic-coated area is clean.

9. **NOTE:** If the moulding is already on the windshield glass, proceed to the next step.

   Align the "V" notch in the ceramic paint and windshield outside molding at top center. Fully seat the windshield outside molding along the top edge of the windshield glass and along the sides and bottom edges of the windshield glass.

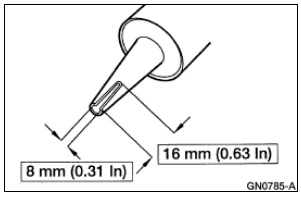
10. Remove the dual lock windshield glass stop adhesive backing.

11. ⚠ **CAUTION: Wipe off the urethane glass prep immediately after each application because it flash dries. Apply deliberate strokes, making sure not to overlap the applied area.**

    If installing a new windshield glass, apply Urethane Glass Prep Essex U-401 meeting Ford specification WSB-M2G314-B twice around the glass surface to be prepped.

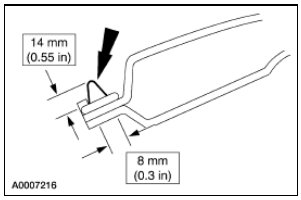
12. If installing a new windshield glass, apply Urethane Glass Primer Essex U-402 meeting Ford specification WSB-M5B280-C to the same area that was prepped in the previous step. Allow five minutes to dry.

13. Cut the urethane adhesive applicator tip to specification.



14. ⚠ **CAUTION: If the vehicle is to be driven within 24 hours of urethane adhesive application, Urethane Adhesive Essex U-216 meeting Ford specification WSB-M2G316-B must be used due to its one-hour cure time.**

    Apply a bead of Urethane Adhesive Essex 400-HV or Essex U-216 meeting Ford specification WSB-M2G316-B to the pinch weld just outside the foam dam.



15. ⚠ **CAUTION: Before installing the windshield glass, open the windows slightly to prevent the windshield from being pushed out by air pressure as the door is closed.**

    NOTE: The windshield glass must be positioned within 10 minutes of applying the urethane adhesive.

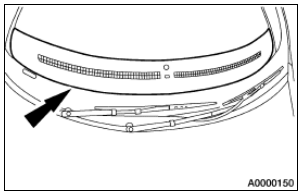
    Install the windshield glass on the vehicle, aligning it with marks made previously.

16. Check the windshield installation for air or water leaks through the urethane bead and add urethane adhesive where needed.

17. Place two strips of duct tape onto the windshield glass and secure it to the roof panel. This will help avoid misalignment while the urethane cures.

18. Install the windshield drip mouldings.
    - Install the eight screws.

19. Install the instrument panel defrost opening grille assembly.
    - Connect the electrical connector.



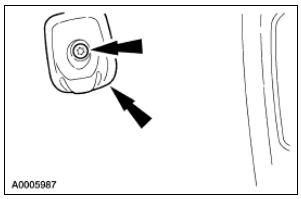
20. Connect the two heated wiper park grid electrical connectors.

21. Position the headliner.

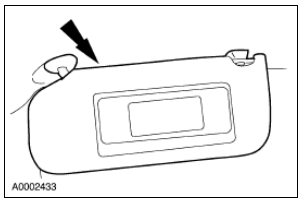
22. Install the weatherstrips.

23. Install the LH and RH windshield side garnish mouldings. For additional information, refer to Section 501-05 .

24. Install the sun visor clips and screws.



25. Install the sun visors and screws.
    - Connect the electrical connectors.



26. Install the rain sensor module. For additional information, refer to Section 501-16 .

27. Install the rear view mirror. For additional information, refer to Section 501-09 .

28. Install the cowl vent screen. For additional information, refer to Section 501-02 .

Torque Specifications

Description	Nm	lb-ft	lb-in
Bulkhead electrical connector bolt	3		27
Floor console assembly rear screws	8		71
Floor console air conditioning duct mounting screw	2		18
Floor console assembly front screws	1		9
Glove compartment bin screws	1		9
Glove compartment door bolts	6		53
Hood release handle screws	2		18
Instrument panel cowl side bolts	20	15	
Instrument panel cowl side nuts	20	15	
Instrument panel cowl top screws	3		27
Instrument panel reinforcement bolts	20	15	
Instrument panel tunnel brace bolts	20	15	
Intermediate shaft to steering column pinch bolt	35	26	

Instrument Panel

The instrument panel consists of the following components:

- passenger air bag module
- instrument panel cluster finish panel
- glove compartment
- instrument cluster
- audio unit
- climate control head
- instrument panel finish panels
- instrument panel defroster opening grille
- instrument panel steering column cover reinforcement
- instrument panel steering column cover

Console Floor

The floor console consists of the following components:

- console air condition duct
- console base assembly (automatic transmission)
- console base assembly (manual transmission)
- console rear finish panel assembly
- console finish panel assembly

The console finish panel assembly consists of the following components:

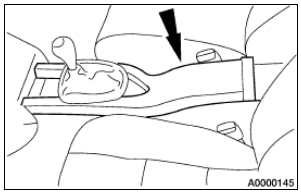
- armrest assembly
- dual cupholder assembly
- phone presenter assembly

Instrument Panel

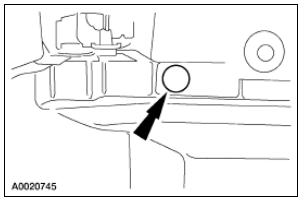
Removal

⚠ CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

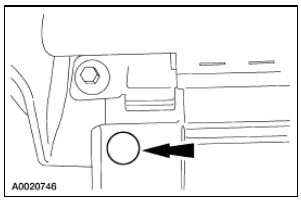
1. Position the steering wheel in the straight ahead position.
2. Remove the driver air bag module. For additional information, refer to Section 501-20B .
3. Remove the floor console. For additional information, refer to Console Floor in this section.
4. Remove the console A/C duct.



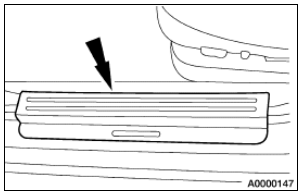
5. If equipped, remove the automatic transmission selector lever assembly. For additional information, refer to Section 307-05 .
6. Remove the three pin-type retainers and the LH instrument panel insulator.
   - Disconnect the courtesy lamp.



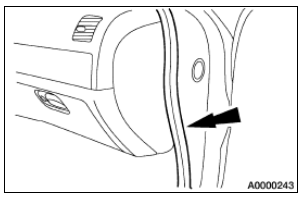
7. Remove the two pin-type retainers and the RH instrument panel insulator.
   - Disconnect the courtesy lamp.



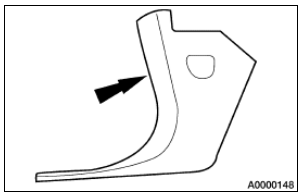
8. Remove the LH and RH scuff plates.



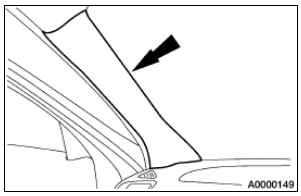
9. Position the LH and RH door weatherstrips aside.



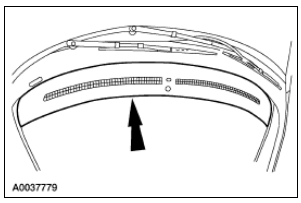
10. Remove the LH and RH A-pillar lower trim panels.



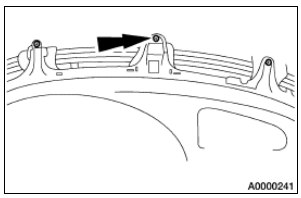
11. Remove the LH and RH windshield side garnish mouldings.



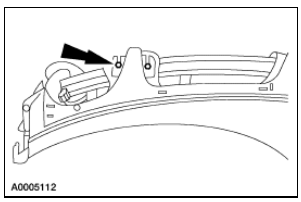
12. Remove the instrument panel defroster opening grille assembly.
    - Disconnect the electrical connector.



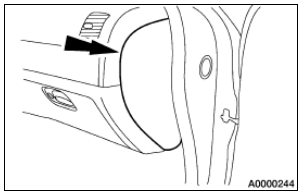
13. Remove the instrument panel cowl top screws.



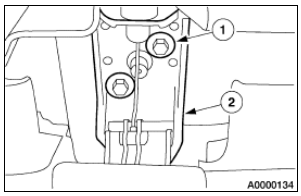
14. Loosen the instrument panel upper reinforcement bolts.



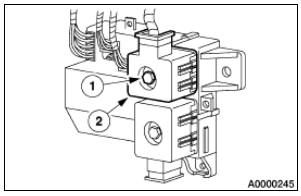
15. Remove the LH and RH instrument panel side finish panels.



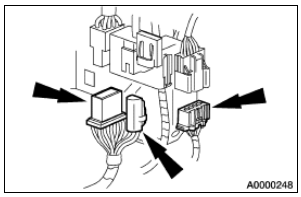
16. Position the hood release handle and cable aside.
    1. Remove the screws.
    2. Position the hood release handle and cable aside.



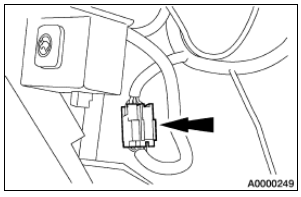
17. Disconnect the upper RH bulkhead electrical connector.
    1. Loosen the bolt.
    2. Disconnect the upper RH bulkhead electrical connector.



18. Disconnect the RH electrical connectors through the instrument panel side opening.



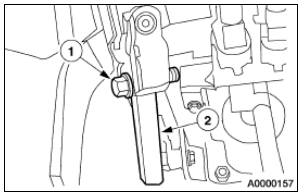
19. Disconnect the passenger side tunnel electrical connector.



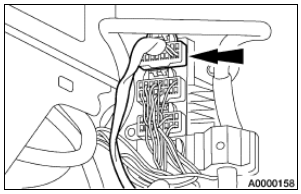
20. **⚠ CAUTION: Secure the steering wheel to prevent any rotation or damage to the air bag sliding contact.**

    Separate the intermediate shaft from the steering column.

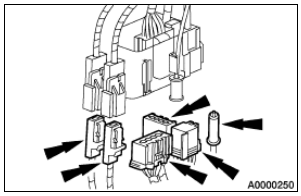
    1. Remove the pinch bolt.
    2. Separate the intermediate shaft from the steering column.



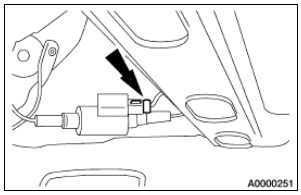
21. Disconnect the LH junction box electrical connector.
    - Position the carpet aside to gain access to the connector.



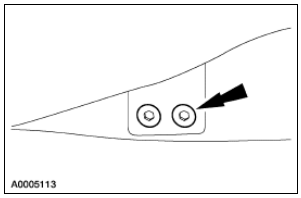
22. Disconnect the LH electrical connectors through the instrument panel side opening.



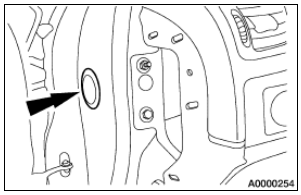
23. If equipped, disconnect the ignition shift interlock electrical connector.



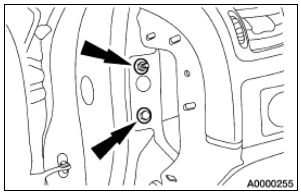
24. Remove the four instrument panel tunnel brace bolts.
    - Position the carpet aside to gain access to the bolts.



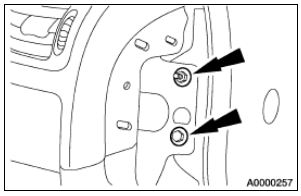
25. Remove the driver side outer instrument panel cowl side cover and reinforcement bolt.



26. Remove the LH instrument panel cowl side bolt and nut.



27. Remove the RH instrument panel cowl side bolt and nut.



28. **NOTE:** Two technicians are required to carry out this step.

    Remove the instrument panel.

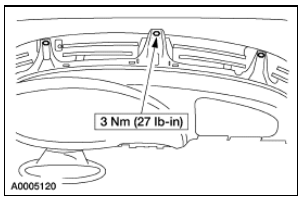
Installation

⚠ CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

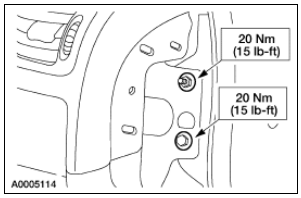
1. **NOTE:** Two technicians are required to carry out this step.

   Install the instrument panel.

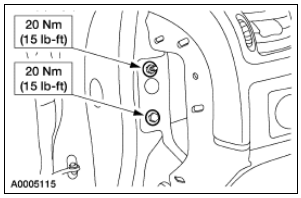
2. Install the instrument panel cowl top screws.



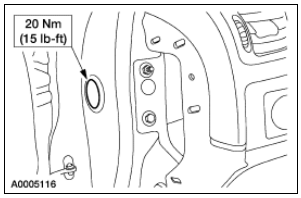
3. Install the RH instrument panel cowl side bolt and nut.



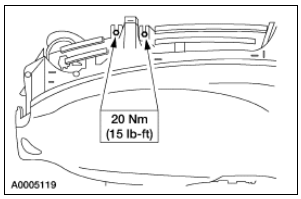
4. Install the LH instrument panel cowl side bolt and nut.



5. Install the driver side outer instrument panel cowl side reinforcement bolt and cover.



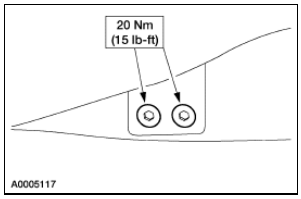
6. Tighten the instrument panel upper reinforcement bolts.



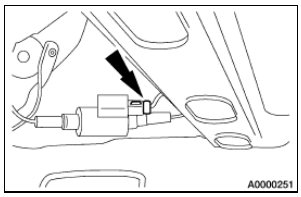
7. **CAUTION: Be sure the steering column cover reinforcement is in place before completing this step.**

   Install the four instrument panel tunnel brace bolts.

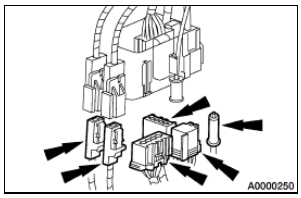
   - Reposition the carpet.



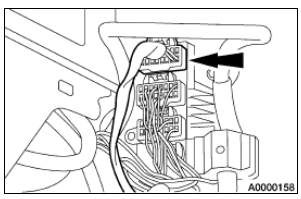
8. If equipped, connect the ignition shift interlock electrical connector.



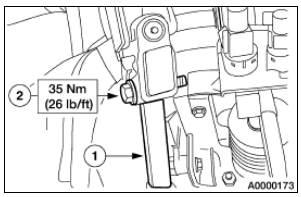
9. Connect the LH electrical connectors through the instrument panel side opening.



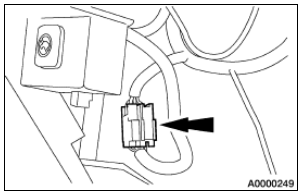
10. Connect the LH junction box electrical connector.
    - Reposition the carpet.



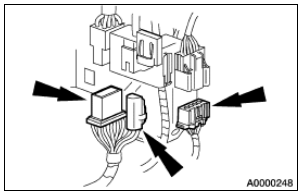
11. Connect the intermediate shaft to the steering column.
    1. Connect the intermediate shaft to the steering column.
    2. Install the pinch bolt.



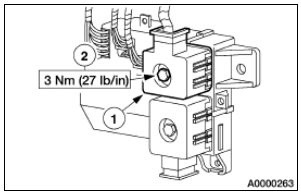
12. Connect the passenger side tunnel electrical connector.



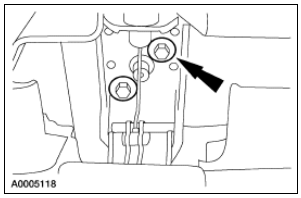
13. Connect the RH electrical connectors through the instrument panel side opening.



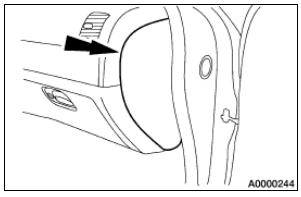
14. Connect the RH bulkhead electrical connector.
    1. Connect the RH bulkhead electrical connector.
    2. Tighten the bolt.



15. Position the hood release handle and cable and install the screws.

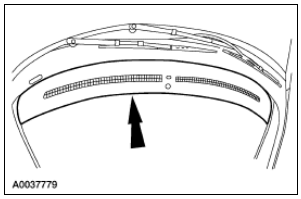


16. Install the LH and RH instrument panel side finish panels.

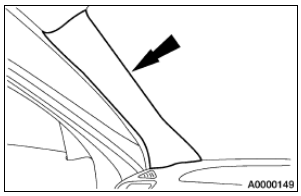


17. Install the instrument panel defroster opening grille assembly.

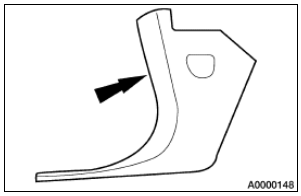
- Connect the electrical connector.



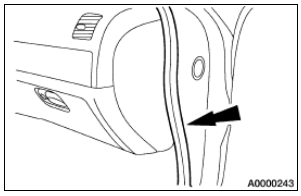
18. Install the LH and RH windshield side garnish mouldings.



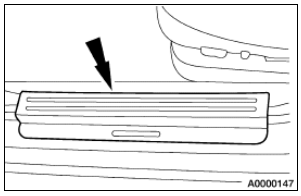
19. Install the LH and RH A-pillar lower trim panels.



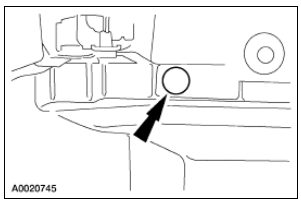
20. Install the LH and RH door weatherstrips.



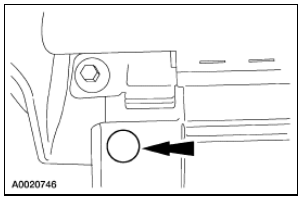
21. Install the LH and RH scuff plates.



22. Position the LH instrument panel insulator and install the three pin-type retainers.
    - Connect the courtesy lamp.

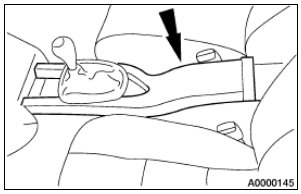


23. Position the RH instrument panel insulator and install the two pin-type retainers.
    - Connect the courtesy lamp.



24. If equipped, install the automatic transmission selector lever assembly. For additional information, refer to Section 307-05 .

25. Install the console A/C duct.



26. Install the floor console. For additional information, refer to Console - Floor in this section.

27. Install the driver air bag module. For additional information, refer to Section 501-20B .

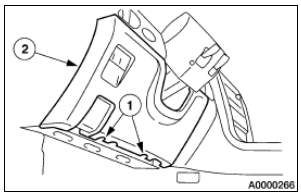
Instrument Panel Cluster Finish Panel

Removal and Installation

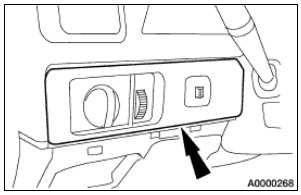
1. Adjust the steering column to the full tilt down and full extended position.

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

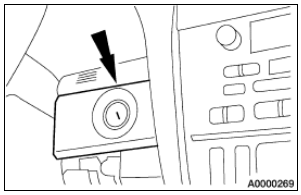
3. Remove the instrument panel steering column cover.
    1. Remove the pin-type retainers.
    2. Remove the instrument panel steering column cover.
    - Disconnect the electrical connectors.



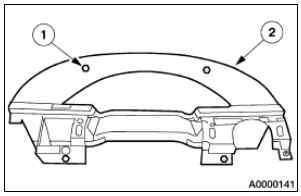
4. Remove the outer instrument panel finish panel.
    - Disconnect the electrical connectors.



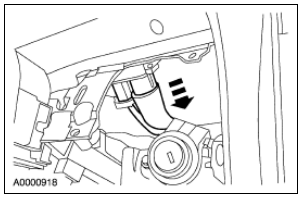
5. Remove the inner instrument panel finish panel.



6. Position the instrument panel cluster finish panel aside.
    1. Remove the screws.
    2. Remove the instrument panel cluster finish panel.



7. Disconnect the in-car air temperature sensor and remove the instrument panel cluster finish panel.



8. To install, reverse the removal procedure.

Console Floor

Removal and Installation

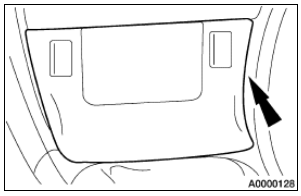
1. Apply the parking brake.

2. If equipped with a manual transmission, place the selector lever in fourth gear.

3. If equipped with an automatic transmission, place the selector lever in neutral.

4. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

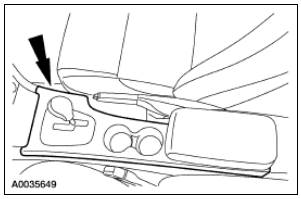
5. Remove the ashtray finish panel.
   - Disconnect the electrical connectors.



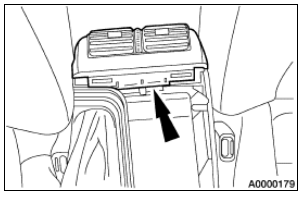
6. If equipped with a manual transmission, remove the gearshift lever knob.

7. If equipped, disconnect the cellular phone electrical connectors.

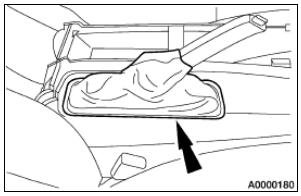
8. Remove the console finish panel assembly by pulling upward from the front first.
   - If equipped, disconnect the traction control switch electrical connector.
   - If equipped, release the cellular phone wiring harness from the console finish panel assembly.



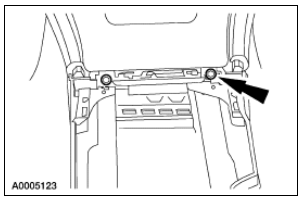
9. Remove the console rear finish panel assembly.
   - Unclip by pulling rearward.



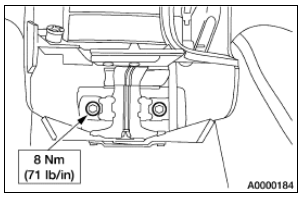
10. Unclip the parking brake boot from the console base.



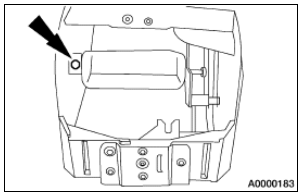
11. Remove the console assembly front screws.



12. Remove the console assembly rear screws.



13. Remove the console air conditioning duct mounting screw.



14. Remove the console assembly by sliding rearward.

15. To install, reverse the removal procedure.

Console Floor, Finish Panel Assembly

Removal and Installation

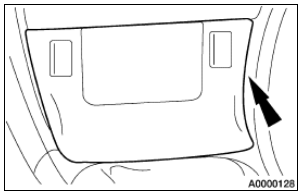
1. Apply the parking brake.

2. If equipped with a manual transmission, place the selector lever in fourth gear.

3. If equipped with an automatic transmission, place the selector lever in neutral.

4. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

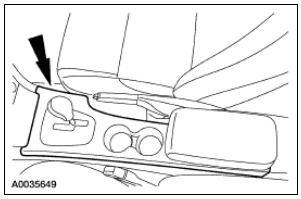
5. Remove the ashtray finish panel.
   - Disconnect the electrical connectors.



6. If equipped with a manual transmission, remove the gearshift lever knob.

7. If equipped, disconnect the cellular phone electrical connectors.

8. Remove the console finish panel assembly by pulling upward from the front first.
   - If equipped, disconnect the traction control switch electrical connector.
   - If equipped, release the cellular phone wiring harness from the console finish panel assembly.



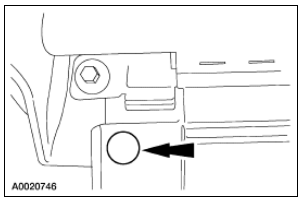
9. To install, reverse the removal procedure.

Glove Compartment

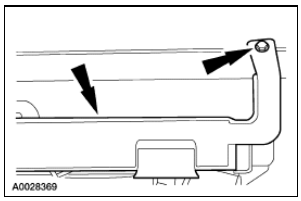
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

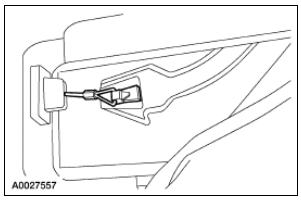
2. Remove the two pin-type retainers and the instrument panel insulator.
   - Disconnect the courtesy lamp.



3. Remove the screw and the floor heat duct.

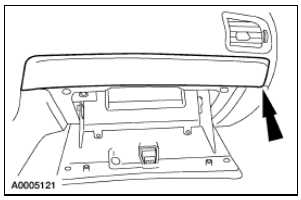


4. From under the instrument panel, release the assist cable from the glove compartment door arm.



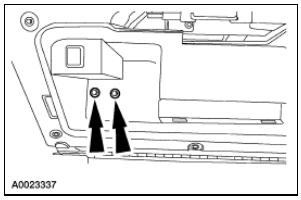
5. Open the glove compartment.

6. Remove the instrument panel finish panel.

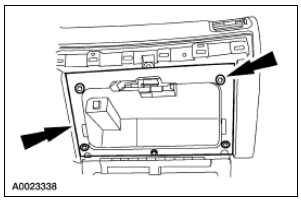


7. Pull up on the glove compartment door arms and lower the glove compartment door.

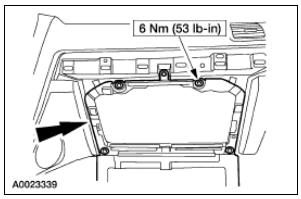
8. Remove the assist cable bracket screws.



9. Remove the screws and the glove compartment bin.
    - Disconnect the electrical connector.



10. Remove the bolts and the glove compartment door.
    - Disconnect the electrical connector.



11. To install, reverse the removal procedure.

General Specifications

Item	Specification
Lubricants	
Multi-Purpose Grease Spray F5AZ-19G209-AA	ESR-M1C159-A
Penetrating and Lock Lubricant E8AZ-19A501-B	

Torque Specifications

Description	Nm	lb-ft	lb-in
Theft shield screw	10		89
Door latch screw	13	10	
Exterior door handle nuts, rear door	11	8	
Exterior door handle nut, front door	10		89
Lock cylinder nut	10		89

LOCK REPAIR/REPLACEMENT SPECIFICATIONS

Part Number	Lock Repair Package Name
11582	Ignition Cylinder
5421990	Door Lock
5443262	Luggage Compartment Lid
5406082	Glove Box
5421970	Lock Lever Kit

Handles, Locks, Latches And Mechanisms

Actuator

The actuator is not repairable and is a part of the latch assembly.

Fuel Filler Door Lock Switch

The fuel filler door lock switch actuates a solenoid integral to the fuel filler door latch to release the fuel tank filler door.

Global Window Open/Close

⚠ WARNING: Disconnect the battery ground cable when working on or near the driver side door cylinder lock rod or door latch. Failure to follow these instructions may result in personal injury.

This vehicle is equipped with a global window open/close feature activated by turning the key to either the lock or unlock position and holding it there for at least three seconds. Turning the key to the lock position will close all of the windows. Turning the key to the unlock position will open all of the windows. This function can accidentally be activated when working around or with the driver side door cylinder lock rod or door latch causing the windows to abruptly open or close. To avoid personal injury, always disconnect the battery ground cable when working on or near the driver side door cylinder lock rod or door latch.

Lock Cylinder Repair

Individual lock cylinders are repaired by discarding the inoperative cylinder and building a new lock cylinder using the appropriate lock repair package. The lock repair package includes a detailed instruction sheet to build the new lock cylinder to the current key code of the vehicle.

Luggage Compartment Remote Control Lock Switch

Refer to Section 501-14B for diagnostics.

Power Locks

The door lock system consists of:

- interior front door latch remote control assembly
- front door latch and cable assembly
- exterior door handle and front door latch actuating rod
- lock cylinder rod
- door latch striker plate
- door lock cylinder
- adjunct actuator

- circuit wiring and circuit protection
- front door lock switch

Refer to Section 501-14B for diagnostics.

Theft Shield

The theft shield is:

- located inside the driver door panel.
- fastened near the bottom of the door and the door handle.

Trunk Release Lockout Switch

The trunk release lockout switch is:

- located within the glove compartment.
- disables the trunk release switch.

Locks, Latches And Mechanisms

Refer to Section 501-14B for power door lock diagnostics.

Refer to Section 501-14B for luggage compartment lid remote control lock switch diagnostics.

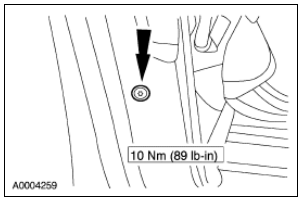
Latch Front Door

Removal and Installation

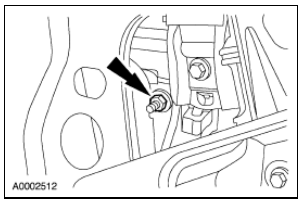
⚠ WARNING: Disconnect the battery ground cable when working on or near the driver side door cylinder lock rod or door latch. Failure to follow these instructions may result in personal injury.

Driver and Passenger Front Door

1. Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .
2. Remove the front door trim panel. For additional information, refer to Section 501-05 .
3. Remove the lower theft shield screw.

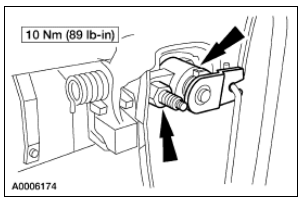


4. Remove the nut and position the theft shield aside .



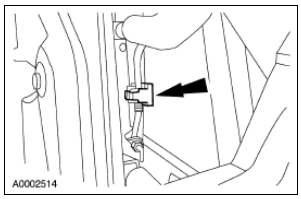
Driver Door Only

5. Remove the nut and the lock cylinder.

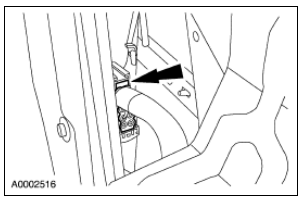


Driver and Passenger Front Door

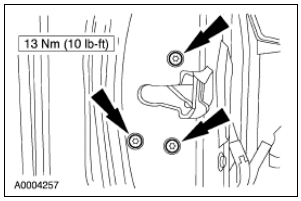
6. Release the clip and disconnect the exterior door handle actuator rod.
   - If equipped, disconnect the door lock cylinder switch electrical connector.



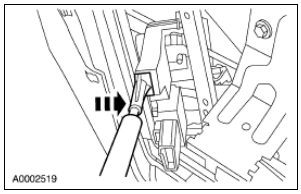
7. Disconnect the electrical connector.



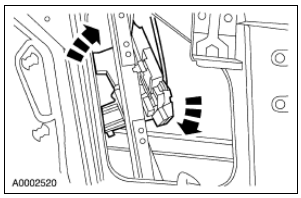
8. Remove the door latch screws.



9. Remove the interior handle actuating cable.



10. Remove the door latch.



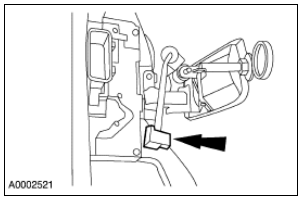
11. To install, reverse the removal procedure.

Latch Rear Door

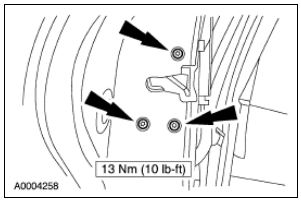
Removal and Installation

1. Remove the rear door trim panel. For additional information, refer to Section 501-05 .

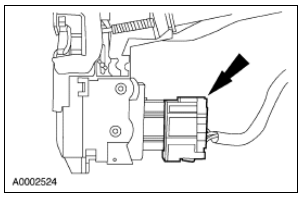
2. Release the clip and disconnect the exterior door handle actuating rod.



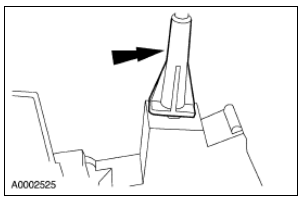
3. Remove the door latch screws.



4. Disconnect the electrical connector.



5. Remove the interior door handle release cable and remove the rear door latch.



6. To install, reverse the removal procedure.

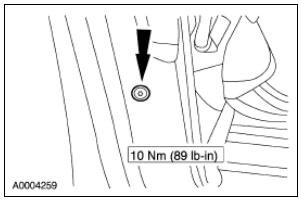
Handle Exterior Front Door

Removal and Installation

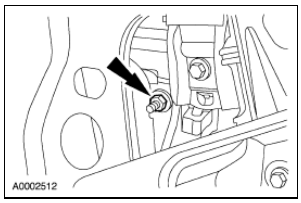
Driver and Passenger Front Door

⚠ WARNING: Disconnect the battery ground cable when working on or near the driver side door cylinder lock rod or door latch. Failure to follow these instructions may result in personal injury.

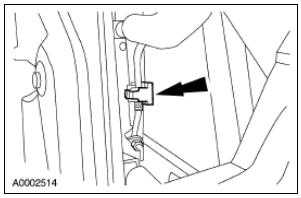
1. Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .
2. Remove the front door trim panel. For additional information, refer to Section 501-05 .
3. Remove the lower theft shield screw.



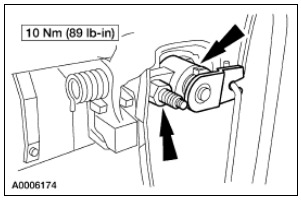
4. Remove the nut and position the theft shield aside.



5. Release the clip and disconnect the exterior door handle actuating rod.
   - If equipped, disconnect the door lock cylinder switch electrical connector.

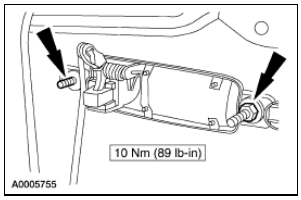


6. Remove the nut and position the door lock cylinder aside.



Driver and Passenger Front Door

7. Remove the nut and the exterior door handle.



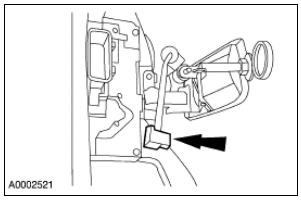
8. To install, reverse the removal procedure.

Handle Exterior Rear Door

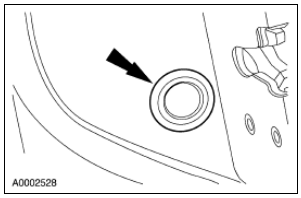
Removal and Installation

1. Remove the rear door trim panel. For additional information, refer to Section 501-05 .

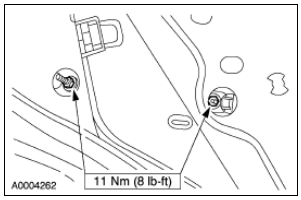
2. Release the clip and disconnect the exterior door handle actuator rod.



3. Remove the grommet.



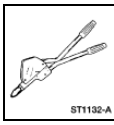
4. Remove the nuts and exterior door handle.



5. To install, reverse the removal procedure.

Handle Interior Door

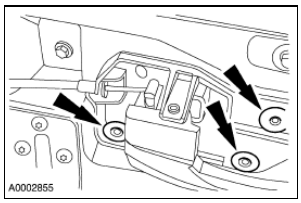
Special Tool(s)

 ST1132-A	Heavy Duty Riveter 501-D011 (D80L-23200-A) or equivalent

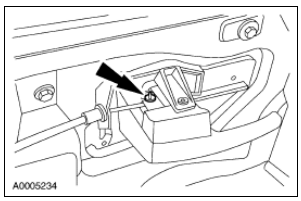
Removal and Installation

1. Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .
2. Remove the door trim panel. For additional information, refer to Section 501-05 .
3. **NOTE:** Using the special tool is required to install the rivets.

   Remove the rivets.



4. Release the cable and remove the interior door handle.



5. To install, reverse the removal procedure.

Lock Cylinder Door

Removal and Installation

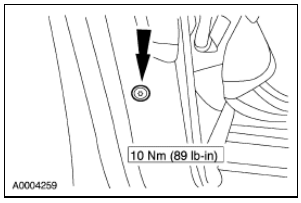
⚠ WARNING: Disconnect the battery ground cable when working on or near the driver side door cylinder lock rod or door latch. Failure to follow these instructions may result in personal injury.

NOTE: Individual lock cylinders are repaired by discarding the inoperative cylinder and building a new lock cylinder using the appropriate lock repair package. The lock repair package includes a detailed instruction sheet to build the new lock cylinder to the current key code of the vehicle.

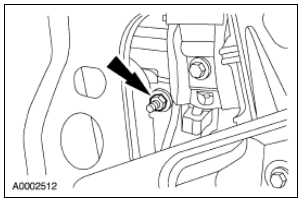
1. Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .

2. Remove the front door trim panel. For additional information, refer to Section 501-05 .

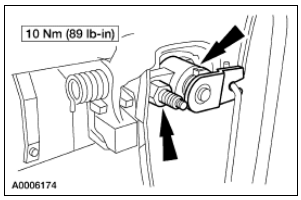
3. Remove the lower theft shield screw.



4. Remove the nut and the theft shield.



5. Remove the lock cylinder nut and remove the lock cylinder.
   - If equipped, disconnect the door lock cylinder switch electrical connector.



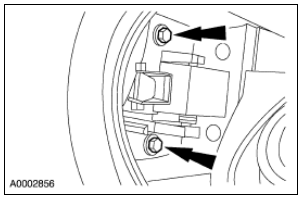
6. To install, reverse the removal procedure.

Latch Remote Control Fuel Door Release

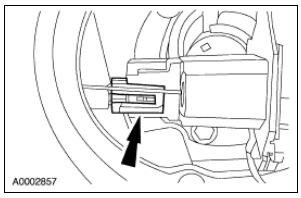
Removal and Installation

1. Remove the fuel filler cap.

2. Remove the bolts and position the fuel door release latch remote control aside.



3. Disconnect the electrical connector and remove the latch remote control.

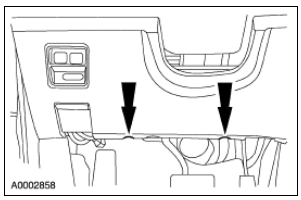


4. To install, reverse the removal procedure.

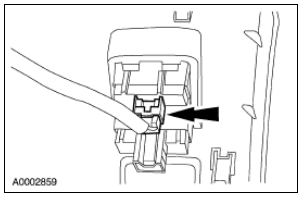
Switch Fuel and Luggage Compartment Lid Release

Removal and Installation

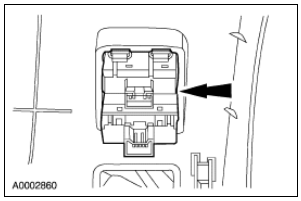
1. Remove the instrument panel steering column cover.



2. Disconnect the electrical connector.



3. Remove the fuel luggage compartment lid release switch.



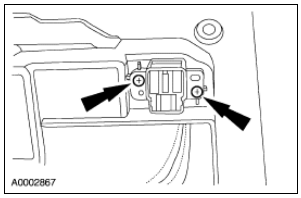
4. To install, reverse the removal procedure.

Switch Luggage Compartment Lid Lockout

Removal and Installation

1. Remove the glove compartment. For additional information, refer to Section 501-12 .

2. Remove the screws and the luggage compartment lid lockout switch.



3. To install, reverse the removal procedure.

Keyless Entry

The keyless entry system consists of the following:

- driver door module (DDM)
- four button remote transmitter
- front electronic module (FEM)
- rear electronic module (REM)

For removal and installation of the actuator, refer to Section 501-14A .

For removal and installation of the driver door module (DDM), refer to Section 419-10 .

For removal and installation of the rear electronic module (REM), refer to Section 419-10 .

For removal and installation of the front electronic module (FEM), refer to Section 419-10 .

Keyless Entry

Refer to Wiring Diagrams Cell 111 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool
 ST1137-A	73III Automotive Meter or equivalent 105-R0057

Principles of Operation

The rear electronics module (REM) controls the output functions of the door locks for the following:

- Passenger front door lock actuator
- Passenger rear door lock actuator
- Driver rear door lock actuator

The REM controls the input functions of the door locks for the following:

- Passenger door lock and unlock switch

The driver door module (DDM) controls the output functions of the door locks for the following:

- Driver door lock actuator

The DDM controls the input functions of the door locks for the following:

- Driver door lock and unlock switch

Operating commands for the passenger front, passenger rear and driver rear lock actuators are received in two forms: the standard corporate protocol (SCP) communication network from the DDM or directly from the passenger door lock and unlock switch, which is hardwired to the REM. The driver door lock and unlock switch is hardwired to the DDM. When the driver switch is activated, the DDM will activate the driver door lock actuator and also sends a message through the SCP network. In turn, the REM will output the desired command to the appropriate lock actuators. When the passenger door lock and unlock switch is activated, the REM will activate the lock actuators, which it controls, and it will also send a message through the SCP network to the DDM to activate the driver door lock actuator.

Operating commands for the driver actuator are received in two forms: through the SCP communication network from the REM or directly from the driver door lock and unlock switch, which is hardwired to the DDM. The passenger door lock and unlock switch is hardwired to the REM. When the passenger switch is activated, the REM will activate the passenger front, passenger rear, and driver rear door lock actuators and also send a message through the SCP network. In turn, the DDM will output the desired command to the

driver front door lock actuator. When the driver door lock and unlock switch is activated, the DDM will activate the driver lock actuator, which it controls, and it will also send a message through the SCP network to the REM to activate the appropriate door lock actuators.

Operating commands for the luggage compartment release lock motor are received in two forms: directly from the luggage compartment release switch which is hardwired to the REM, or through the SCP network from the DDM. When the luggage compartment release switch is activated , the REM will activate the luggage compartment lock actuator, which is hardwired to the REM. The luggage compartment unlock operation is also possible when activated from the remote transmitter through the DDM, with the DDM sending a message over the SCP network. The REM will then activate the luggage compartment release motor.

The DDM receives inputs from the remote transmitter(s) and delivers outputs enabling the driver to lock and unlock the vehicle's power lock system, or to arm and disarm the perimeter alarm. The DDM can be programmed to accept up to four transmitter ID codes from four remote transmitters.

Remote locking and unlocking of the doors is accomplished by the DDM receiving a command message from the remote transmitter. The DDM then processes the command and sends a signal directly to the driver door lock actuator, and sends a message through the SCP network, to the REM which will drive the appropriate passenger door lock actuators. Fault management will disable the remote locking and unlocking feature in the event of an ignition switch or PRNDL invalid or missing message to the front electronic module (FEM).

All power door locks and the luggage compartment release motor are powered by the switched system power (SSP) feature. A failure of any or all of the SSP features could cause inoperative power door locks. When diagnosing power door locks, it is essential to determine if all the related symptoms and DTCs are controlled by the SSP feature.

Inspection and Verification

1. Verify the customer concern by operating the system.

2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Door lock mechanisms	• Central junction box (CJB) Fuses: ♦ 222 (10A) ♦ 207 (5A) • Battery junction box (BJB) Fuses: ♦ 401 (15A) ♦ 422 (20A) ♦ 425 (40A) • DDM • REM • FEM • Circuitry

	• Remote transmitter

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTICS. If the diagnostic tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for DDM, go to Pinpoint Test A.
   - NO RESP/NOT EQUIP for REM, go to Pinpoint Test B.
   - NO RESP/NOT EQUIP for FEM, go to Pinpoint Test R.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs, and carry out self-test diagnostics for the DDM, FEM or REM.

6. If the DTCs retrieved are related to the concern, go to DDM Diagnostic Trouble Code (DTC) Index , REM Diagnostic Trouble Code (DTC) Index, FEM Diagnostic Trouble Code (DTC) Index, or SSP Relay Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1309	Power Door Lock Circuit Short to Ground	DDM	GO to Pinpoint Test C .
B1341	Power Door Unlock Circuit Short to Ground	DDM	GO to Pinpoint Test C .
B1342	ECU Is Defective	DDM	INSTALL a new DDM. REFER to Section 419-10 . REPEAT the self-test. CLEAR the DTCs.
B1400	Driver Power Window One Touch Window Relay Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1405	Driver Power Window Down Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1408	Driver Power Window Up Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1416	Power Window LR Motor Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1420	Passenger Power Window Motor Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1424	Power Window RR Motor Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1530		DDM	REFER to Section 501-09 .

	Memory Set Switch Circuit Short to Ground		
B1534	Memory 1 Switch Circuit Short to Ground	DDM	REFER to Section 501-09 .
B1538	Memory 2 Switch Circuit Short to Ground	DDM	REFER to Section 501-09 .
B1676	Battery Pack Voltage Out of Range	DDM	REFER to Section 414-00 .
B2112	Door Driver Set Switch Stuck Failure	DDM	GO to Pinpoint Test E .
B2116	Door Driver Reset Switch Stuck Failure	DDM	GO to Pinpoint Test E .
B2320	Mirror Driver Horizontal Feedback Potentiometer Circuit Failure	DDM	REFER to Section 501-09 .
B2324	Mirror Driver Vertical Feedback Potentiometer Circuit Failure	DDM	REFER to Section 501-09 .
B2336	Mirror Switch Assembly Circuit Failure	DDM	REFER to Section 501-09 .
B2425	Remote Keyless Entry Out of Synchronization	DDM	GO to Pinpoint Test L .
B2477	Module Configuration Failure	DDM	REFER to Section 418-01 .

FEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1319	Driver Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1327	Passenger Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1342	ECU Is Defective	FEM	INSTALL a new FEM. REFER to Section 419-10 . REPEAT the self-test. CLEAR the DTCs.
B1438	Wiper Mode Select Switch Circuit Failure	FEM	REFER to Section 501-16 .
B1446	Wiper Park Sense Circuit Failure	FEM	REFER to Section 501-16 .
B1479	Wiper Washer Fluid Level Sensor Circuit Failure	FEM	REFER to Section 413-01 .
B1499	Lamp Turn Signal Left Circuit Failure	FEM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1503	Lamp Turn Signal Right Circuit Failure	FEM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1519	Hood Switch Circuit Failure	FEM	REFER to Section 419-01A .
B1567	Lamp Headlamp High Beam Circuit Failure	FEM	REFER to Section 417-01 .
B1676	Battery Pack Voltage Out of Range	FEM	REFER to Section 414-00 .
B1794	Lamp Headlamp Low Beam Circuit Failure	FEM	REFER to Section 417-01 .
B2214	Window Passenger Front Up Switch Short to Battery	FEM	REFER to Section 501-11 .
B2215	Window Passenger Front Down Switch Short to Battery	FEM	REFER to Section 501-11 .

B2312	Mirror Passenger Horizontal Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2316	Mirror Passenger Vertical Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2477	Module Configuration Failure	FEM	REFER to Section 418-01 .
C1284	Oil Pressure Switch Failure	FEM	REFER to Section 413-01 .
C1446	Brake Switch Circuit Failure	FEM	REFER to Section 413-01 .
C1924	VAPS Solenoid Actuator Output Circuit Short to Ground	FEM	REFER to Section 211-00 .
C1925	VAPS Solenoid Actuator Return Circuit Failure	FEM	REFER to Section 211-00 .
U1027	SCP (J1850) Invalid or Missing Data for Engine RPM	PCM	CARRY OUT the PCM self-test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test. REFER to Section 206-09A .
U1059	SCP (J1850) Invalid or Missing Data for Transmission / Transaxle / PRNDL	PCM	CARRY OUT the PCM self-test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the ICM self-test. REFER to Section 413-01 .
U1222	SCP (J1850) Invalid or Missing Data for Interior Lamps	ICM	CARRY OUT the ICM self-test. REFER to Section 413-01 .
U1227	SCP (J1850) Invalid or Missing Data for Body Status Request	ICM	CARRY OUT the ICM self-test. REFER to Section 413-01 .

REM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1201	Fuel Sender Circuit Failure	REM	REFER to Section 413-01 .
B1300	Power Door Lock Circuit Failure	REM	GO to Pinpoint Test D .
B1310	Power Door Unlock Circuit Failure	REM	GO to Pinpoint Test D .
B1331	Decklid Ajar Rear Door Circuit Failure	REM	REFER to Section 417-02 .
B1335	Door Ajar RR Circuit Failure	REM	REFER to Section 417-02 .
B1342	ECU Is Defective	REM	INSTALL a new REM. REFER to Section 419-10 . REPEAT the self-test. CLEAR the DTCs.
B1483	Brake Pedal Input Circuit Failure	REM	REFER to Section 417-01 .
B1499	Lamp Turn Signal Left Circuit Failure	REM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	REM	REFER to Section 417-01 .
B1503	Lamp Turn Signal Right Circuit Failure	REM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	REM	REFER to Section 417-01 .
B1551	Decklid Release Circuit Failure	REM	GO To Pinpoint Test J .
B1571	Door Ajar LR Circuit Failure	REM	REFER to Section 417-02 .

B1676	Battery Pack Voltage Out of Range	REM	REFER to Section 414-00 .
B2172	Inertia Switch input Circuit Open	REM	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
B2174	Window Driver Rear Remote Up Switch Short to Battery	REM	REFER to Section 501-11 .
B2178	Window Driver Rear Remote Down Switch Short to Battery	REM	REFER to Section 501-11 .
B2190	Window Passenger Rear Remote Up Switch Short to Battery	REM	REFER to Section 501-11 .
B2194	Window Passenger Rear Remote Down Switch Short to Battery	REM	REFER to Section 501-11 .
B2477	Module Configuration Failure	REM	REFER to Section 418-01 .
U1059	SCP (J1850) Invalid or missing Data for Transmission/Transaxle/ PRNDL	PCM	CARRY OUT the PCM self-test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test. REFER to Section 206-09A .
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the Instrument Cluster self-test. REFER to Section 413-01 .

SSP Relay Index

Relay	Fuse	Controlled System(s)
SSP1	BJB Fuse 430 (30A)	• Driver power door lock (FEM) • LH and RH high beam headlamps (FEM) • RF park, turn, and side marker lamps (FEM) • RH low beam headlamp • Driver power mirror
SSP2	BJB Fuse 431 (30A)	• LH low beam headlamp (FEM) • LF park, turn, and sidemarker lamps (FEM) • Interior courtesy and demand lighting • Windshield wiper washer pump • Switch illumination backlighting
SSP3	BJB Fuse 424 (30A)	• High mounted stoplamp (REM) • RR park and stoplamps (REM) • Reversing lamps (REM) • LR turn signals (REM) • Passenger power mirror • Trailer stoplamps and turn signals (if equipped with trailer tow)
SSP4	BJB Fuse 423 (30A)	• LR park and stoplamps (REM)

		• RR turn signals (REM) • Passenger door and side locks (REM) • License lamps • Trunk release solenoid and switch • Fuel door release solenoid and switch • Trunk lamp • Trailer park lamps (if equipped with trailer tow)

When diagnosing an SSP relay, check that all systems for that relay are inoperative. Refer to Section 417-01 if:

- all systems for one SSP relay are inoperative
- all systems for all SSP relays are inoperative

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE DRIVER DOOR MODULE (DDM)

PINPOINT TEST B: NO COMMUNICATION WITH THE REAR ELECTRONIC MODULE (REM)

PINPOINT TEST C: ALL DOOR LOCKS ARE INOPERATIVE FROM DRIVER DOOR SWITCH

PINPOINT TEST D: ALL DOOR LOCKS ARE INOPERATIVE FROM PASSENGER DOOR SWITCH

PINPOINT TEST E: ALL DOOR LOCKS ARE INOPERATIVE FROM DRIVER DOOR LOCK CYLINDER

PINPOINT TEST F: A SINGLE DOOR LOCK IS INOPERATIVE DRIVER DOOR

PINPOINT TEST G: MORE THAN ONE DOOR LOCK IS INOPERATIVE PASSENGER DOOR, RIGHT REAR DOOR, AND LEFT REAR DOOR

PINPOINT TEST H: MORE THAN ONE DOOR LOCK IS INOPERATIVE PASSENGER DOOR AND RIGHT REAR DOOR

PINPOINT TEST I: A SINGLE DOOR LOCK IS INOPERATIVE LEFT REAR DOOR

PINPOINT TEST J: THE LUGGAGE COMPARTMENT DOOR IS INOPERATIVE FROM RELEASE SWITCH

PINPOINT TEST K: THE LUGGAGE COMPARTMENT DOOR IS INOPERATIVE FROM RELEASE SWITCH AND REMOTE TRANSMITTER

PINPOINT TEST L: THE DOORS DO NOT LOCK AND UNLOCK USING THE REMOTE TRANSMITTER

PINPOINT TEST M: THE MEMORY SEAT DOES NOT OPERATE CORRECTLY USING THE REMOTE TRANSMITTER

PINPOINT TEST N: THE AUTO-LOCK DOES NOT OPERATE CORRECTLY

PINPOINT TEST O: THE SMART LOCK DOES NOT OPERATE CORRECTLY

PINPOINT TEST P: PANIC FEATURE IS INOPERATIVE

PINPOINT TEST Q: THE LUGGAGE COMPARTMENT DOOR IS INOPERATIVE USING THE REMOTE TRANSMITTER

PINPOINT TEST R: NO COMMUNICATION WITH THE FRONT ELECTRONIC MODULE (FEM)

Programming Remote Keyless Entry Transmitter

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052 or equivalent

NOTE: All remote transmitters are programmable and must be set at the same time.

NOTE: To program (or reprogram) the remote transmitters into the driver door module (DDM), carry out the following steps:

1. Connect the New Generation STAR/Service Bay Diagnostic System (diagnostic tool/SBDS) tester. Turn the ignition from OFF to RUN.

2. From diagnostic tool/SBDS: Using the Ford Service Function (FSF) card, select SERVICE BAY FUNCTION.

3. Select DDM.

4. Select KEY FOB PROGRAMMING.

5. Press any button on the remote transmitter.

6. Select the FOB 1, 2, 3, or 4, and select STORE. It may be necessary to select CANCEL more than once to exit the menu.

7. Repeat steps five and six for additional transmitters.

8. **NOTE:** It may be necessary to select CANCEL more than once to exit the menu.

   Select CANCEL to exit the menu.

General Specifications

Item	Specification
RH wiper blade adjustment tolerance	12mm (.47in)
LH wiper blade adjustment tolerance	10mm (.39in)

Torque Specifications

Description	Nm	lb-ft	lb-in
Battery ground cable	10		89
Degas bottle bolts	10		89
Mounting arm and pivot shaft bolts	12	9	
Pivot arm nuts	25	18	
Strut support brace bolts	20	15	
Windshield washer fluid reservoir bolt	6		53
Windshield wiper motor bolts	12	9	
Windshield wiper motor crank bolt	12	9	

Wipers and Washers

The wiper and washer system consists of:

- pivot arms
- mounting arm and pivot shaft
- windshield wiper motor
- windshield washer fluid pump
- headlamp washer fluid pump (if equipped)
- windshield washer fluid reservoir
- front electronic module (FEM)
- rear electronic module (REM)
- rain sensor module (RSM) (if equipped)

Wipers and Washers

Refer to Wiring Diagrams Cell 81 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool
 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST1453-A	Alternator, Regulator, Battery and Starter Tester (ARBST) 010-00725 or equivalent

Principles of Operation

Wipers and Washers

The wiper and washer systems are controlled by the front electronic module (FEM). The wiper/washer portion of the multifunction switch is hardwired to the FEM. When the switch is moved to the desired position, the FEM processes this information and outputs the appropriate command(s) to one of three relays. The relays control the wiper high and low motor speeds and washer pump actuation. Intermittent wiper speed control can vary dependent upon vehicle speed. This is accomplished by the FEM receiving vehicle speed information from the anti-lock brake control module and throttle position status from the powertrain control module (PCM). When the wiper switch is in any of the intermittent positions, the FEM will process the information from the PCM and anti-lock brake control module and decrease the wiper delay time as vehicle speed increases.

Rain Sensor Wiper Function Rain Sensor Module

The rain sensor module (RSM) is located on the inside of the windshield below the interior rear view mirror and the direct pattern of the wiper blades, if equipped. When the ignition switch is turned to the RUN position, the RSM starts monitoring both the DELAY/WASH and the wiper mode circuits. When the multifunction switch is placed into the INT and AUTO positions, the rain sensor takes control of the mode circuit. In dry conditions the RSM keeps the mode circuit at the correct voltage for the OFF position. In the presence of moisture the RSM directs the mode circuit into individual low pulse, or continuous LOW or HIGH operation, based on the amount of moisture.

Low Washer Fluid Level Lamp/Indicator

The low washer fluid lamp/indicator feature is controlled by the FEM and instrument cluster. The low washer fluid switch is hardwired to the FEM. If fluid is low, the FEM will send a message via the standard corporate protocol (SCP) communication network to the instrument cluster. The instrument cluster will then process the message and output an audible and visual warning. If equipped with a message center, a warning message will be displayed. For additional information, refer to Section 413-08 .

Heated Wiper Park

The heated wiper park feature is controlled by the dual automatic temperature control (DATC) module. For additional information, refer to Section 501-11 .

Inspection and Verification

1. Verify the customer concern by operating the windshield wiper and washer system to duplicate the condition.

2. Visually inspect for the obvious signs of mechanical or electrical damage; refer to the following chart.

Visual Inspection Chart

Mechanical	Electrical
• Wiper blade • Binding wiper pivot arm • Binding wiper mounting arm and pivot shaft • Empty washer reservoir • Washer hoses	• Underhood auxiliary junction box (AJB) Fuses: ♦ 102 (10A) ♦ 120 (30A) • Battery junction box (BJB) Fuses: ♦ 422 (20A) ♦ 423 (30A) ♦ 424 (30A) ♦ 425 (40A) ♦ 427 (30A) ♦ 432 (30A) • Central junction box (CJB) Fuse 205 (5A) • Wiper motor • Washer pump • Connectors or connections • Circuitry • Multifunction switch • Wire harness routing • FEM • Instrument cluster

3. If the fault is not visually evident, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:

- CKT914, CKT915, or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
- NO RESP/NOT EQUIP for FEM, go to Pinpoint Test A.
- SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out the self-test diagnostics for the generic electronic module.

6. If the DTCs retrieved are related to the concern, go to FEM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart.

FEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1319	Driver Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1327	Passenger Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1342	ECU Is Defective	FEM	CLEAR the DTC. REPEAT the FEM self-test. If DTC B1342 is retrieved, INSTALL a new FEM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test.
B1438	Wiper Mode Select Switch Circuit Failure	FEM	GO to Pinpoint Test D .
B1446	Wiper Park Sense Circuit Failure	FEM	GO to Pinpoint Test B .
B1479	Wiper Washer Fluid Level Sensor Circuit Failure	FEM	REFER to Section 413-01 .
B1499	Lamp Turn Signal Left Circuit Failure	FEM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1503	Lamp Turn Signal Right Circuit Failure	FEM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1519	Hood Switch Circuit Failure	FEM	REFER to Section 419 01A.
B1567	Lamp Headlamp High-Beam Circuit Failure	FEM	REFER to Section 417-01 .
B1676	Battery Pack Voltage Out of Range	FEM	REFER to Section 414-00 .
B1794	Lamp Headlamp Low-Beam Circuit Failure	FEM	REFER to Section 417-01 .
B2214	Window Passenger Front Up Switch Short to Battery	FEM	REFER to Section 501-11 .
B2215	Window Passenger Front Down Switch Short to Battery	FEM	REFER to Section 501-11 .

B2312	Mirror Passenger Horizontal Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2316	Mirror Passenger Vertical Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2443	Powertrain Performance Mode Switch Circuit Failure	FEM	Not Used
B2477	Module Configuration Failure	FEM	REFER to Section 418-01 .
C1284	Oil Pressure Switch Failure	FEM	REFER to Section 413-01 .
C1446	Brake Switch Circuit Failure	FEM	REFER to Section 413-01 .
C1924	VAPS Solenoid Actuator Output Circuit Short to Ground	FEM	REFER to Section 211-00 .
C1925	VAPS Solenoid Actuator Return Circuit Failure	FEM	REFER to Section 211-00 .
U1027	SCP (J1850) Invalid or Missing Data for Engine RPM	PCM	CARRY OUT the PCM self-test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test. REFER to Section 206-09A .
U1059	SCP (J1850) Invalid or Missing Data for Transmission / Transaxle / PRNDL	PCM	CARRY OUT the PCM self-test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the ICM self-test. REFER to Section 413-01 .
U1222	SCP (J1850) Invalid or Missing Data for Interior Lamps	ICM	CARRY OUT the ICM self-test. REFER to Section 413-01 .
U1227	SCP (J1850) Invalid or Missing Data for Body Status Request	ICM	CARRY OUT the ICM self-test. REFER to Section 413-01 .

SSP Relay Index

Relay	Fuse	Controlled System(s)
SSP1	BJB Fuse 427 (30A)	• Driver power door lock (FEM) • LH high beam headlamps (FEM) • RF park/turn/side marker lamps (FEM) • RH low beam headlamp • Driver exterior rear view mirror • LF park/turn/side marker lamps (FEM)
SSP2	BJB Fuse 432 (30A)	• LH low beam headlamp (FEM) • RH high beam headlamps (FEM) • Passenger exterior rear view mirror (FEM) • Switch illumination backlighting
SSP3	BJB Fuse 424 (30A)	• High mounted stoplamp (REM)

		• RR park/stoplamps (REM) • Reversing lamps (REM) • LR turn signals (REM) • Interior courtesy and demand lighting (FEM)
SSP4	BJB Fuse 423 (30A)	• LR park/stoplamps (REM) • RR turn signals (REM) • All passenger door locks (REM) • License lamps • Luggage compartment release solenoid/switch • Fuel door release solenoid/switch • Luggage compartment lamp

When diagnosing an SSP relay, check that all systems for that relay are inoperative. REFER to Section 417-01 .

Symptom Chart

Symptom Chart

Pinpoint Tests

⚠ CAUTION: Electronic modules are sensitive to electrical charges. If exposed to these charges, damage may result.

PINPOINT TEST A: NO COMMUNICATION WITH THE FRONT ELECTRONIC MODULE (FEM)

PINPOINT TEST B: THE WIPERS ARE INOPERATIVE

PINPOINT TEST C: THE WIPERS STAY ON CONTINUOUSLY

PINPOINT TEST D: THE HIGH/LOW WIPER SPEEDS DO NOT OPERATE CORRECTLY

PINPOINT TEST E: THE WASH AND WIPE FUNCTION DOES NOT OPERATE CORRECTLY

PINPOINT TEST F: THE WASHER PUMP IS INOPERATIVE/ON CONTINUOUSLY

PINPOINT TEST G: THE SPEED DEPENDENT INTERVAL MODE DOES NOT OPERATE CORRECTLY

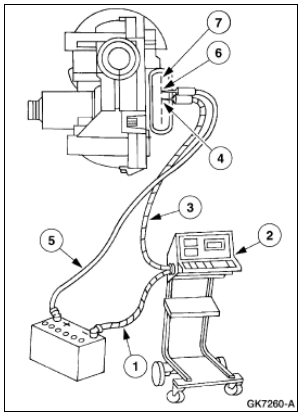
PINPOINT TEST H: THE RAIN MOISTURE SENSITIVE FUNCTION DOES NOT OPERATE CORRECTLY

Component Test

Windshield Wiper Motor

⚠ CAUTION: Do not handle the wiper motor abusively when diagnosing the wiper operations. Failure to follow this caution may result in damage to the motor magnets and will make the wiper motor inoperative. Rough handling of new replacement wiper motors may also damage the motor magnets.

Use Alternator, Regulator, Battery and Starter Tester (ARBST) to test the wiper motor on the vehicle.



To test the wiper motor, disconnect the windshield wiper mounting arm and pivot shaft from the windshield wiper motor; refer to Pivot Arm .

Disconnect the wiper motor. Connect the (1) green lead from (2) (ARBST) to the battery negative (-) post. Connect the (3) red lead from ARBST to the wiper motor (4) common brush terminal (terminal 3).

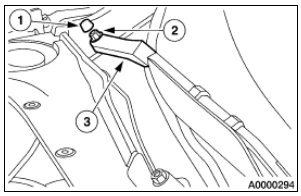
Test the low speed mode by connecting a (5) cable from the battery positive (+) post to the (6) low speed brush terminal (terminal 4) and measure the current draw. If the current draw is greater than 3.5 amperes, install a new windshield wiper motor.

Test the high speed mode by connecting a cable from the battery positive (+) post to the (7) high speed brush terminal (terminal 5) and measure the current draw. If the current draw is greater than 5.5 amperes, install a new wiper motor.

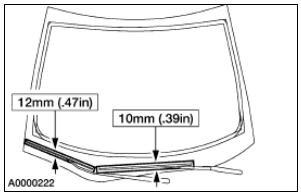
Wiper Blade and Pivot Arm Adjustment

1. Cycle and park the windshield wipers.

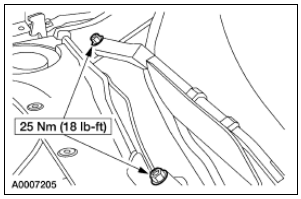
2. Remove the pivot arm(s).
    1. Remove the pivot arm nut cover(s).
    2. Remove the nut(s).
    3. Remove the pivot arm(s).



3. Install the wiper blade and pivot arm onto the pivot shaft and align the blade to the silver dots in the windshield.



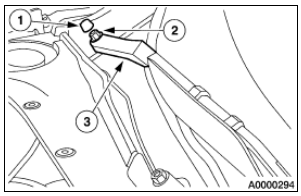
4. Tighten the windshield wiper pivot arm nut(s).
    - Install the pivot arm nut cover(s).



Pivot Arm

Removal

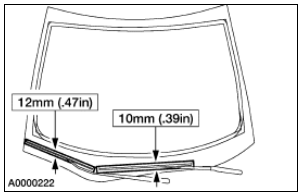
1. Remove the pivot arm (RH shown, LH similar).
    1. Remove the pivot arm nut cover.
    2. Remove the nut.
    3. Remove the pivot arm.



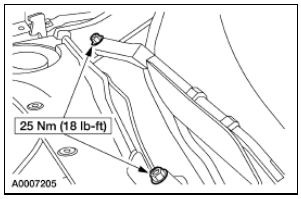
Installation

1. Cycle and park the windshield wipers.

2. Install the wiper blade and pivot arm onto the pivot shaft and align the blade to the silver dots in the windshield.



3. Tighten the windshield pivot arm nuts.
    - Install the pivot arm nut covers.



Mounting Arm and Pivot Shaft

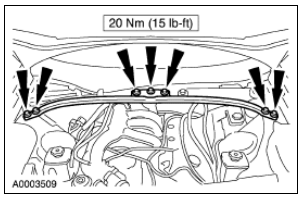
Removal and Installation

1. ⚠ **CAUTION: The windshield wiper system has an auto park feature. It is necessary to disconnect the battery.**

   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

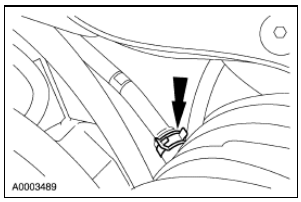
2. Remove the cowl top vent panels. For additional information, refer to Section 501-02 .

3. Remove the bolts and the strut tower support brace.



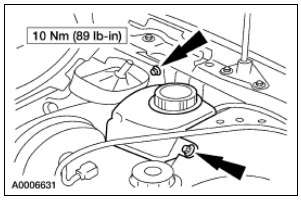
4. Partially drain the engine cooling system. For additional information, refer to Section 303-03 .

5. Disconnect the degas return hose from the degas return tube.

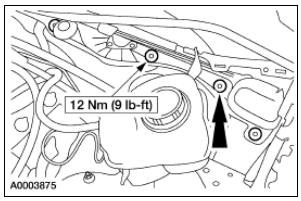


6. **NOTE:** When positioning the degas bottle aside it will be necessary to reroute the degas bottle lower hose in front of the brake booster.

   Remove the bolts and position the degas bottle aside.

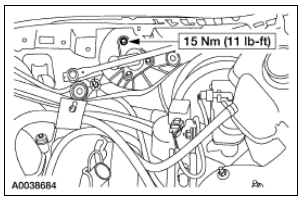


7. Remove the windshield wiper mounting arm and pivot shaft bolts.



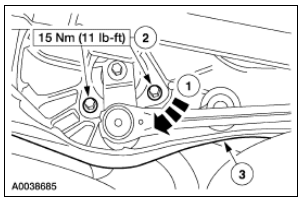
8. Disconnect the drain boot from the windshield wiper mounting arm and pivot shaft assembly.

9. Position the windshield wiper mounting arm and pivot shaft assembly aside, and loosen the upper windshield wiper motor bolt.



10. Remove the windshield wiper mounting arm and pivot shaft assembly.
    1. Rotate wiper output arm to the six o'clock position.
    2. Remove the lower wiper motor bolts.
    3. **NOTE:** It is necessary to rotate the bottom of the windshield wiper mounting arm and pivot shaft assembly upward.

       Remove the windshield wiper mounting arm and pivot shaft assembly.
    - Disconnect the electrical connector.



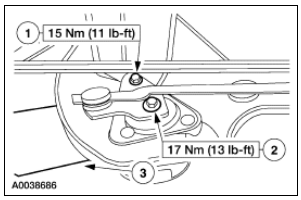
11. To install, reverse the removal procedure.

Windshield Wiper Motor

Removal and Installation

1. Remove the windshield wiper mounting arm and pivot shaft (17566) assembly; refer to Mounting Arm and Pivot Shaft in this section.

2. Remove the windshield wiper motor (17508).
    1. Remove the bolt.
    2. Remove the windshield wiper motor crank bolt.
    3. Remove the windshield wiper motor.



3. To install, reverse the removal procedure.

Washer Pump and Reservoir

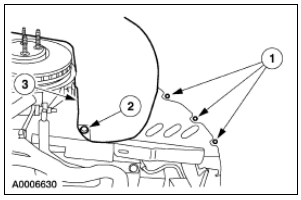
Removal and Installation

1. ⚠ **CAUTION: Do not make electrical connections prior to filling the windshield washer reservoir. Do not operate the windshield washer pump prior to filling the windshield washer reservoir.**

   Disconnect the battery ground cable. Refer to Section 414-01 .

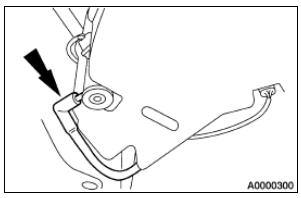
2. Remove the RF wheel and tire assembly. For additional information, refer to Section 204-04 .

3. Position RF fender splash shield aside.
   1. Remove the screws.
   2. Remove the pin-type retainers.
   3. Position the RF splash shield aside.

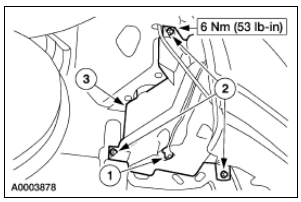


4. **NOTE:** Windshield washer fluid should be collected in a container after the windshield washer hose is disconnected.

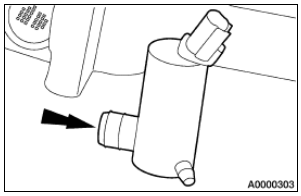
   Disconnect the washer hose.



5. Remove the washer fluid reservoir.
   1. Disconnect the two electrical connectors.
   2. Remove the bolts.
   3. Remove the washer reservoir.



6. If necessary remove the windshield washer pump and if equipped remove the headlamp washer pump.



7. To install, reverse the removal procedure.

Module Rain Sensor

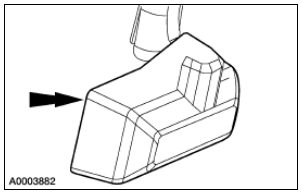
Removal and Installation

1. **NOTE:** To avoid damage to the rain sensor module cover, push up on the cover while rotating the top of the cover toward the rear of the vehicle.

   NOTE: Prior to installing the rain sensor module, the windshield glass area between the rain sensor module brackets must be cleaned.

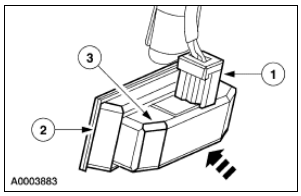
   NOTE: When installing the rain sensor module, it is necessary to apply inward pressure on the module prior to locking the rain sensor module retaining slides in place.

   Remove the rain sensor module cover (17D550).



2. Remove the rain sensor module 17D547.
   1. Pull the latch on the connector away from the harness and disconnect the electrical connector.
   2. **NOTE:** When removing the rain sensor module, it is necessary to apply inward pressure on the module prior to releasing the rain sensor module retaining slides.

      Release the rain sensor module retaining slides.
   3. Remove the rain sensor module.



3. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Roof opening panel assembly bolts	10	89
Roof opening glass assembly screws	4	35
Roof opening panel control module bolts	3	27
Roof opening panel motor assembly bolts	6	53

Roof Opening Panel

The roof opening panel consists of the following components:

- Left sight shield
- Right sight shield
- Water trough
- Roof opening panel opening shield
- Roof opening panel assembly
- Roof opening panel track and rail assembly
- Roof opening panel control module
- Roof opening panel motor assembly
- Roof opening glass assembly
- Roof opening glass seal

The roof opening panel is available as an option. The roof opening panel control module controls the roof opening panel. The roof opening panel may be operated from the roof opening panel switch or the global open and close function.

Roof Opening Panel

Refer to Wiring Diagrams Cell 101 for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool

Principles of Operation

Roof Opening Panel Control Module

Battery power is continuously supplied to the roof opening panel control module. However, the roof opening panel will only operate from the roof opening panel switch with the ignition switch in the RUN or ACCY position. The global open and close feature is controlled by two circuits from the rear electronic module (REM). The two circuits must be at ground potential before the roof opening panel control module will acknowledge the roof opening panel switch. When the ignition switch is turned to RUN or ACCY, the REM provides ground to these circuits.

The roof opening panel control module incorporates soft stops at the end of all travel positions. The roof opening panel control module monitors the internal switches to determine the roof opening glass position and the soft stops. The internal switches are activated by the roof opening panel motor rotation.

The roof opening panel control module supplies the power and ground to the roof opening panel motor depending on the ordered function. Power is supplied to the roof opening panel motor for a maximum of 12 seconds. Under normal operation, position is monitored by the roof opening panel control module and power is removed from the roof opening panel motor as soon as the roof opening panel reaches the commanded position.

Roof Opening Panel Switch

Four circuits connect the roof opening panel switch to the roof opening panel control module. One circuit is the common return. The other three are the control circuits open, close and tilt. The roof opening panel control module monitors these lines for voltage fluctuation to determine which function was selected.

With the ignition switch in the RUN or ACCY position, the roof opening panel supplies a five volt reference voltage to the three control lines. Activation of the roof opening panel switch connects one or more of these lines to the common return which pulls the line low. The roof opening panel control module will sense the line or lines being connected to the common line and carry out the appropriate function.

The express open function connects the open and tilt circuits to the common return when the roof opening panel switch is moved rearward to the second detent position. The operator-controlled open function connects

the open circuit to the common return. The close function connects the close circuit to the common causing the roof opening panel to close from a slide or vent position.

Global Open and Close

Two circuits connect the REM to the roof opening panel control module for these functions. Global open and close operation for the roof opening panel is controlled by one of these two circuits being grounded by the REM.

Global open and close operation is only available with the ignition in the OFF position and the ignition key removed.

When the ignition switch is in the RUN or ACCY position, the REM grounds both of these circuits allowing normal operation of the roof opening panel from the roof opening panel switch.

When global open or close operation is selected, the roof opening panel switch is not recognized by the roof opening panel control module throughout the operation and five seconds after the operation is completed.

With the ignition switch in the OFF position, the roof opening panel control module supplies a constant voltage to these two circuits. The roof opening panel control module monitors these lines for a low state, caused by the REM grounding the line, to determine the ordered global function by the REM.

Global open is commanded by the REM grounding control line two. Line one will remain at previous voltage.

Global close is commanded by the REM grounding control line one. Line two will remain at previous voltage.

If both lines have voltage, the roof opening panel will be inoperative.

The global open function is activated by:

- unlocking the driver door using the remote keyless entry transmitter. Within five seconds, press and hold the unlock button.
- unlocking the driver door using the driver door lock cylinder and the key. Hold the key in the unlock position.

The global close function is activated by:

- turning the driver door lock cylinder to the lock position and holding.

Global open and close operates as follows:

- With the roof opening glass in the flush position, activating global open will operate the roof opening glass to the full open position.
- With the roof opening glass in the open position, activating global close will close the roof opening glass to the flush position.
- If a global open is commanded within five seconds of a completed global operation, the roof opening panel control module will reverse the previous completed global operation. If the roof opening glass was globally closed from the vent position, a global open within five seconds would tilt the roof opening glass back up.
- If the roof opening glass was globally closed from the slide open position, a global open within five seconds would slide the roof opening glass back open.

Inspection and Verification

1. Verify the customer concern by operating the system.

2. Visually inspect for obvious signs of mechanical or electrical damage.

   Visual Inspection Chart

Mechanical	Electrical
• Roof opening panel track and rail assembly • Roof opening glass seal • Roof opening glass adjustment • Roof opening panel assembly timing	• Battery junction box (BJB) Fuse 416 (20A) • Central junction box (CJB) Mini Fuse 207 (5A) • Roof opening panel switch • Roof opening panel motor assembly • Rear electronics module (REM) • Roof opening panel control module • Wiring harness • Loose or corroded connections

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTIC TEST. If the diagnostic tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for REM, Go To Pinpoint Test A .
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the REM.

6. If the DTCs retrieved are related to the concern, go to REM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

REM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1201	Fuel Sender Circuit Failure	REM	REFER to Section 413-01 .
B1300	Power Door Lock Circuit Failure	REM	REFER to Section 501-14B .
B1310	Power Door Unlock Circuit Failure	REM	REFER to Section 501-14B .
B1331	Decklid Ajar Rear Door Circuit Failure	REM	REFER to Section 417-02 .
B1335	Door Ajar RR Circuit Failure	REM	REFER to Section 417-02 .

B1342	ECU Is Defective	REM	CLEAR the DTC. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new REM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self test.
B1483	Brake Pedal Input Circuit Failure	REM	REFER to Section 417-01 .
B1499	Lamp Turn Signal Left Circuit Failure	REM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	REM	REFER to Section 417-01 .
B1503	Lamp Turn Signal Right Circuit Failure	REM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	REM	REFER to Section 417-01 .
B1551	Decklid Release Circuit Failure	REM	REFER to Section 501-14B .
B1571	Door Ajar LR Circuit Failure	REM	REFER to Section 417-02 .
B1676	Battery Pack Voltage Out of Range	REM	REFER to Section 414-00 .
B2172	Inertia Switch Input Circuit Open	REM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
B2174	Window Driver Rear Remote Up Switch Short to Battery	REM	REFER to Section 501-11 .
B2178	Window Driver Rear Remote Down Switch Short to Battery	REM	REFER to Section 501-11 .
B2190	Window Passenger Rear Remote Up Switch Short to Battery	REM	REFER to Section 501-11 .
B2194	Window Passenger Rear Remote Down Switch Short to Battery	REM	REFER to Section 501-11 .
B2477	Module Configuration Failure	REM	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the Anti-lock Brake Control Module (ABS) self-test. REFER to Section 206-09A , Section 206-09B , or Section 206-09C .
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/ PRNDL	PCM	CARRY OUT the Powertrain Control Module (PCM) self-test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the Instrument Cluster self-test. REFER to Section 413-01 .

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE REAR ELECTRONIC MODULE (REM)

PINPOINT TEST B: THE ROOF OPENING PANEL LEAKS

PINPOINT TEST C: THE ROOF OPENING PANEL IS NOISY DURING OPERATION

PINPOINT TEST D: THE ROOF OPENING PANEL DOES NOT OPEN OR CLOSE

PINPOINT TEST E: THE ROOF OPENING PANEL DOES NOT OPEN OR CLOSE IN VENT POSITION

PINPOINT TEST F: THE ROOF OPENING PANEL DOES NOT STOP IN FLUSH FROM ANY POSITION

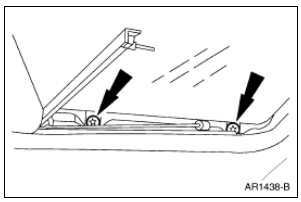
PINPOINT TEST G: THE EXPRESS OPEN IS INOPERATIVE

PINPOINT TEST H: THE ROOF OPENING PANEL HAS EXCESSIVE WIND NOISE

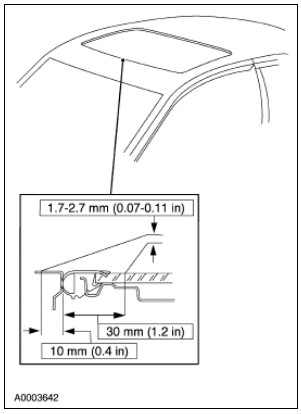
Height Adjustment

1. Operate the roof opening glass assembly to the closed position.

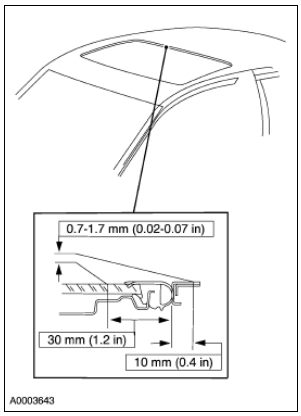
2. Swing the left sight shield and right sight shield rearward and loosen the screws on each side.



3. Adjust the front glass edge to between flush and 1.7 - 2.7 mm (0.07 - 0.11 in) low.

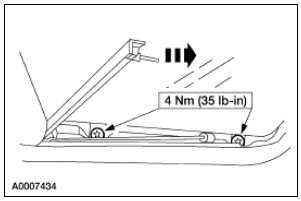


4. Adjust the rear glass edge to between flush and 0.7 - 1.7 mm (0.02 - 0.07 in) low.



5. **NOTE:** Make sure to carefully align the sight shield to the snap retainer prior to positioning into place.

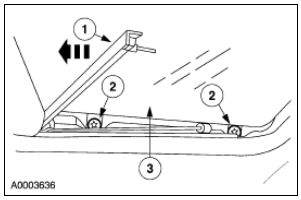
   Tighten the four screws and swing the left and right sight shields forward and snap into place.


4 Nm (35 lb-in)
A0007434

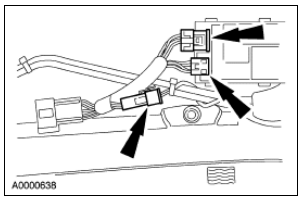
Timing Adjustment

1. Remove the roof opening panel assembly. For additional information, refer to Panel Roof Opening Assembly in this section.

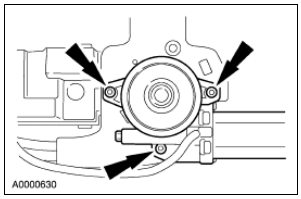
2. Remove the roof opening glass assembly.
    1. Swing the left and right sight shields rearward.
    2. Remove the screws on each side.
    3. From the exterior of the vehicle, lift the roof opening glass assembly from the vehicle.



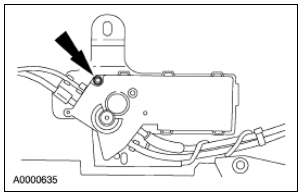
3. Disconnect the connectors.



4. Remove screws and the roof opening panel motor assembly.

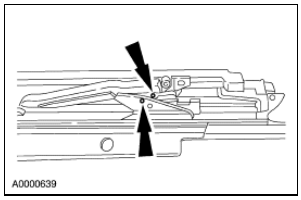


5. Remove the screw and the roof opening panel control module.

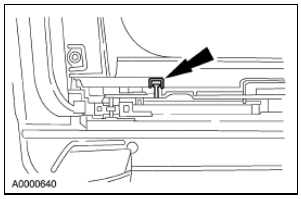


6. **NOTE:** It may be necessary to slightly separate the rail assembly to visually see the two alignment holes.

    Align the holes in the mechanism on each side.



7. Make sure the flush locating pin is centered in the slot on each side.

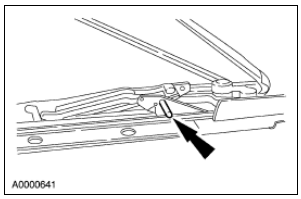


8. **NOTE:** The alignment pins must remain in place until the roof opening panel control module is installed.

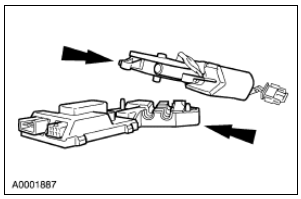
   NOTE: A number 33 drill bit may be used as an alignment pin.

   Install an alignment pin in the alignment hole in each side of the mechanism.

   - The alignment pin should be approximately 2.83 mm (0.11 in) in diameter

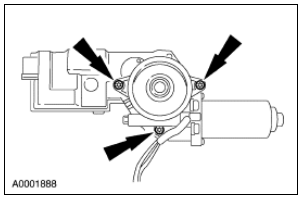


9. Position the roof opening panel motor assembly on the roof opening panel control module.

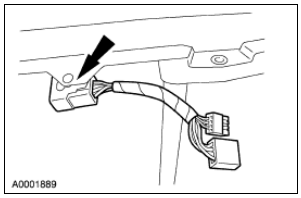


10. ⚠ **CAUTION: Do not snug or overtighten the roof opening panel mounting screws. Damage to the roof opening panel control module may result.**

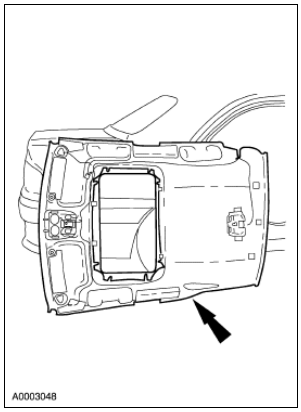
    Install the screws approximately two to three turns.



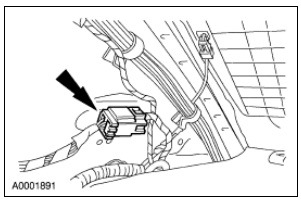
11. Remove the harness from the roof opening panel assembly.



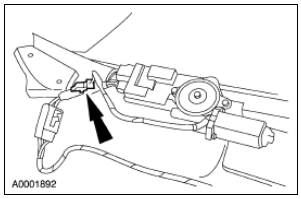
12. Position the headlining panel against the right rear quarter panel.
    - The rear of the headliner should be towards the right rear door opening and the cloth side towards the vehicle.



13. Connect the headlining panel body harness connector at the right rear C-pillar.



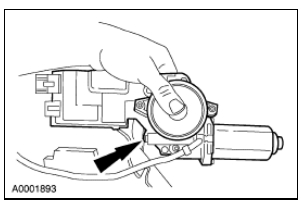
14. Connect the roof opening panel harness between the module motor assembly and the roof opening panel switch.



15. **NOTE:** Make sure the battery is fully charged.

    Turn the ignition switch to RUN.

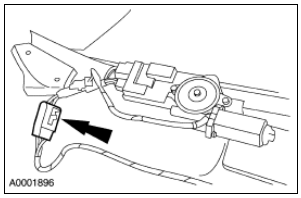
16. Firmly hold the roof opening panel control module and roof opening panel motor together.



17. Operate the roof opening panel switch rearward (OPEN position) until the motor stops.

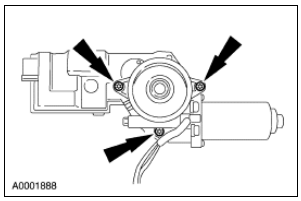
18. Operate the roof opening panel switch forward (CLOSE position) until the motor stops.

19. Disconnect the front body harness connector.

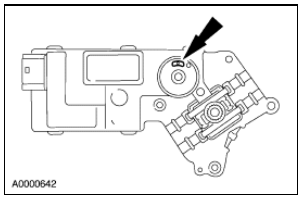


20. **NOTE:** Make sure the roof opening panel control module gear position is not altered.

    Remove the screws.



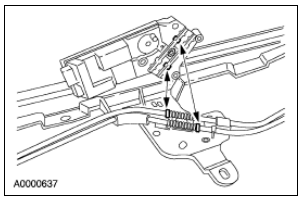
21. Make sure the alignment hole is visible in the view hole.



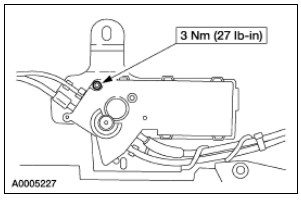
22. **NOTE:** Make sure the roof opening panel control module gear position is not altered.

    Install the roof opening panel control module on the cable sleeves.

    - Make sure the shoulder of each cable sleeve is correctly seated in the roof opening panel control module.

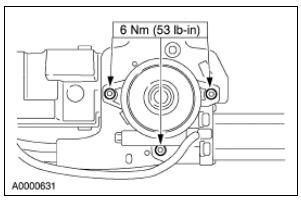


23. Make sure the roof opening panel control module is seated flush to the bracket and install the screw.

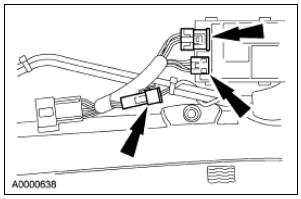


24. **NOTE:** Make sure the roof opening panel motor is correctly aligned and inserted into the control module. The roof opening panel motor should be sitting flush with the frame before installing the bolts.

Position the roof opening panel motor assembly and install the screws.

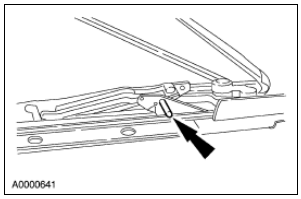


25. Connect the connectors.



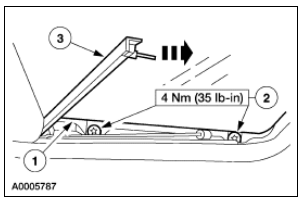
26. Install the roof opening panel harness tie down and clip into place.

27. Remove the alignment pins from each side.



28. Install the roof opening glass assembly.
    1. Install the roof opening glass assembly in place aligning screw holes.
    2. Install the screws on each side.
    3. **NOTE:** Make sure to carefully align the sight shield to the snap retainer prior to positioning into place.

       Swing the left and right sight shields forward and snap into place.



29. Position the roof opening panel assembly near the headliner and connect the roof opening panel harness to the headliner harness.

30. **NOTE:** Make sure the battery is fully charged.

    Operate the roof opening panel to the full open and full close position. Make sure both sides activate at the same time and the roof opening panel operates smoothly without jerking or binding. Make sure both sides reach flush at the same time.

31. Install the roof opening panel assembly. For additional information, refer to Panel Roof Opening Assembly in this section.

32. Adjust the roof opening glass height. For additional information, refer to Height Adjustment in this section.

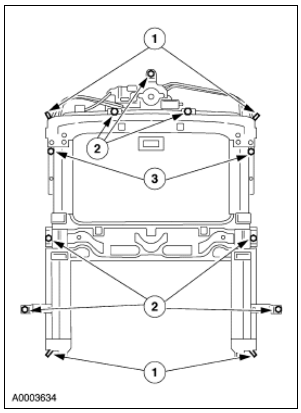
Panel Roof Opening Assembly

Removal

1. Remove the headliner. For additional information, refer to Section 501-05 .

2. Remove the roof opening panel assembly.
    1. Disconnect the drain tubes.
    2. Remove the bolts.
    3. **NOTE:** Support the roof opening panel assembly to prevent the unit from dropping.

       Remove the bolts.

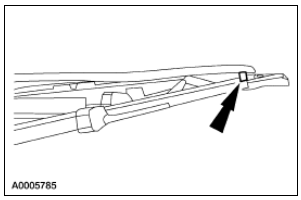


Installation

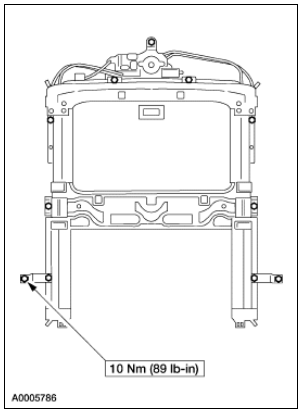
NOTE: The roof opening panel is available as an assembly or a track and rail assembly. The track and rail assembly must have the roof opening glass and the roof opening panel opening shield transferred from the old unit. The roof opening panel assembly can be installed without transferring parts from the old unit.

1. If necessary, transfer the roof opening glass assembly and the roof opening panel opening shield to the new roof opening panel assembly.

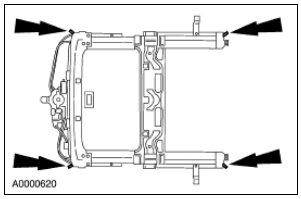
2. Install and support the roof opening panel assembly in the vehicle.
    - Make sure the alignment pins are correctly seated on each side.



3. Install the roof opening panel assembly bolts.



4. Connect the drain tubes.



5. Install the headliner. For additional information, refer to Section 501-05 .

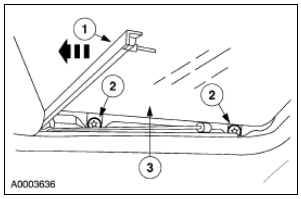
6. Adjust the roof opening glass height. For additional information, refer to Height Adjustment .

Glass Roof Opening Assembly

Removal

1. Operate the roof opening glass assembly to the closed position.

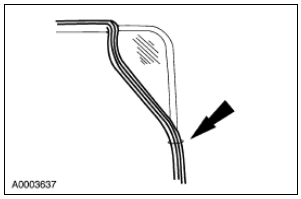
2. Remove the roof opening glass assembly.
    1. Swing the left and right sight shields rearward.
    2. Remove the four screws.
    3. From the exterior of the vehicle, lift the roof opening glass assembly from the vehicle.



3. Remove the roof opening glass seal.

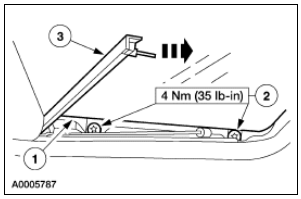
Installation

1. Install the roof opening glass seal.
    - Position the roof opening glass seal seam in the center of the passenger side of the roof opening glass.



2. Install the roof opening glass assembly.
    1. Install the roof opening glass assembly in place aligning screw holes.
    2. Install the four screws.
    3. **NOTE:** Make sure to carefully align the sight shield to the snap retainer prior to positioning into place.

       Swing the left and right sight shields forward and snap into place.



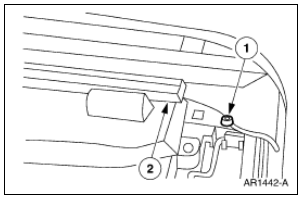
3. Adjust the roof opening glass height. For additional information, refer to Height Adjustment .

Opening Shield Roof Opening Panel

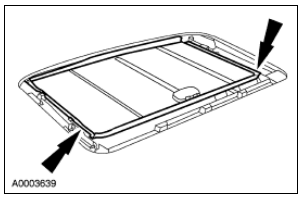
Removal

1. Remove the roof opening glass assembly. For additional information, refer to Glass Roof Opening Assembly .

2. Remove the water trough.
    1. Remove the two screws.
    2. Remove the water trough.

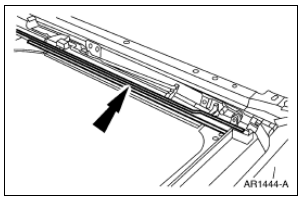


3. Pull the roof opening panel opening shield forward, lifting up slightly at the front openings until the front and rear tabs are disengaged from the track.

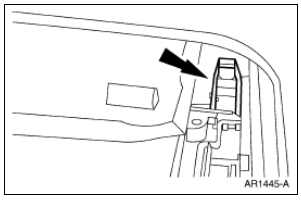


Installation

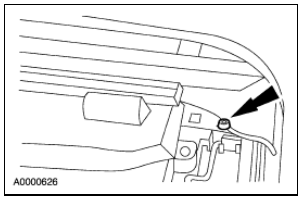
1. Insert the rear tabs into the track and slide the roof opening panel opening shield rearward until the front tabs insert into the track.



2. Install the water trough under the tab on each side.



3. Position the water trough and install the two screws.



4. Install the roof opening glass assembly. For additional information, refer to Glass Roof Opening Assembly .

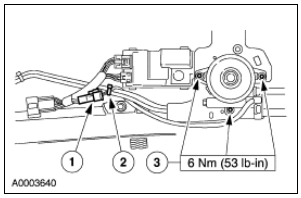
Motor Roof Opening Panel Assembly

Removal and Installation

⚠ **CAUTION: Make sure the roof opening glass assembly is not moved during motor removal or installation. The roof opening panel assembly timing may be affected and cause the roof opening panel assembly to bind or be damaged.**

1. Remove the headliner. For additional information, refer to Section 501-05 .

2. Remove the roof opening panel motor assembly.
    1. Disconnect the electrical connector.
    2. Remove the tie strap.
    3. Remove the bolts.



3. **NOTE:** If the roof opening glass assembly was moved while the roof opening panel motor was removed, the timing must be reset. Refer to Timing Adjustment .

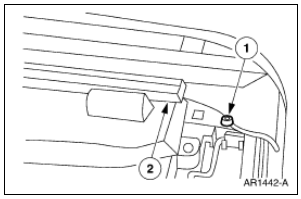
    To install, reverse the removal procedure.

Trough Assembly

Removal

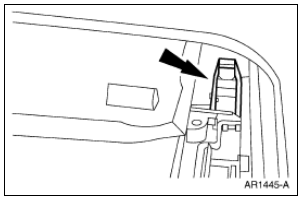
1. Remove the roof opening glass assembly. For additional information, refer to Glass - Roof Opening Assembly .

2. Remove the water trough (5454022).
    1. Remove the two screws.
    2. Remove the water trough.

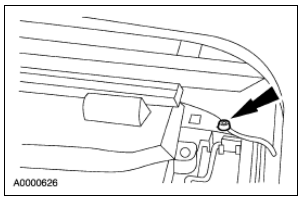


Installation

1. Install the water trough under the tab on each side.



2. Position the water trough and install the two screws.



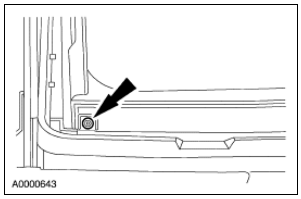
3. Install the roof opening glass assembly. For additional information, refer to Glass - Roof Opening Assembly .

Air Deflector

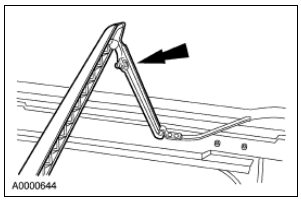
Removal and Installation

1. Move the roof opening glass assembly fully rearward.

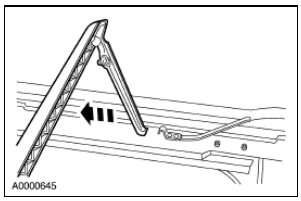
2. Remove the two air deflector screws.



3. Move the air deflector to the complete vertical position.



4. Slide the air deflector rearward to unhook from the frame.



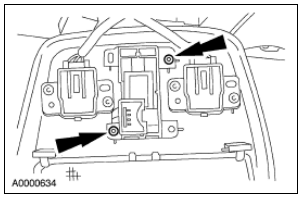
5. To install, reverse the removal procedure.

Switch Roof Opening Panel

Removal and Installation

1. Position the dome/map lamp assembly aside.

2. Disconnect the electrical connector, remove the screws and the roof opening panel switch.



3. To install, reverse the removal procedure.

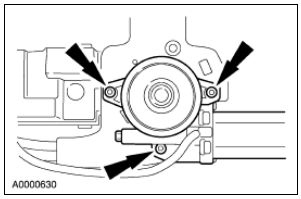
Module Roof Opening Panel Control

Removal

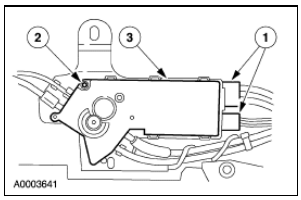
1. **NOTE:** Make sure the roof opening glass assembly is in the closed position.

   Remove the roof opening panel assembly. For additional information, refer to Panel Roof Opening Assembly .

2. Remove the bolts and position the roof opening panel motor assembly aside.



3. Remove the roof opening panel control module.
   1. Disconnect the electrical connectors.
   2. Remove the screw.
   3. Remove the roof opening panel control module.



Installation

1. **NOTE:** Before a new roof opening panel control module can be installed, the roof opening panel and control module must be timed. The timing procedure will install the roof opening panel control module once the unit is timed.

   Carry out the roof opening panel assembly timing. Refer to Timing Adjustment .

Torque Specifications

Description	Nm	lb-ft	lb-in
Front bumper cover bracket bolts	7		62
Rear bumper cover nuts	7		62
Rear bumper cover bolts	7		62
Front bumper bolts (8mm)	25	18	
Rear bumper bolts	23	17	
Exhaust hanger bracket bolt	30	22	
Front bumper bolts (6mm)	10		89

Bumpers

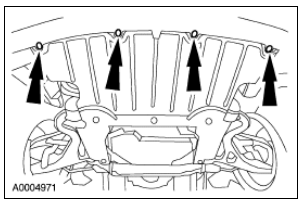
The bumper system consists of the following components:

- Front bumper cover (17D957)
- Front bumper cover trim
- Front bumper (17750)
- Front bumper isolator (17E898)
- Rear bumper cover (17K835)
- Rear bumper cover trim
- Rear bumper (17775)
- Rear bumper isolator (17E899)

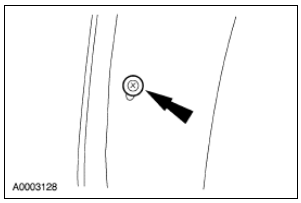
Bumper Cover Front

Removal and Installation

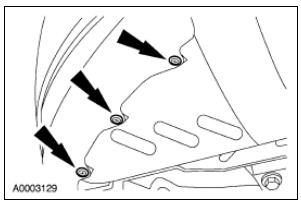
1. Remove the screws.



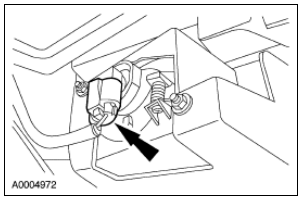
2. Remove the two screws from the inner fender splash shields.



3. Remove the six screws from inner fender splash shields.

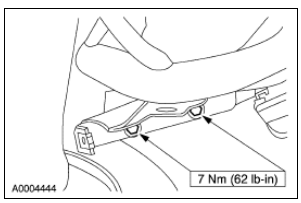


4. Disconnect the two fog lamp electrical connectors.

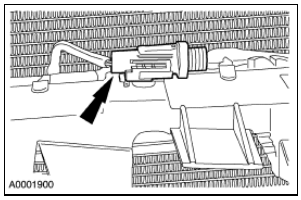


5. Disconnect the two side marker lamp electrical connectors.

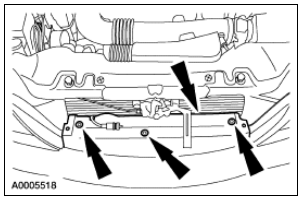
6. Remove the four front bumper cover bracket bolts from the fenders.



7. Release the ambient air temperature sensor.

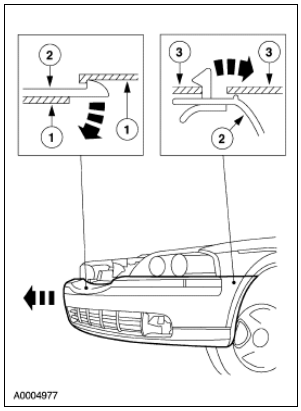


8. Remove the radiator grille opening cover at the top shelf of the bumper.



9. Remove the front bumper cover by pulling the center tabs downward and the outboard tabs on each side outward.

Item	Description
1	Grille opening panel reinforcement
2	Bumper cover
3	Fender



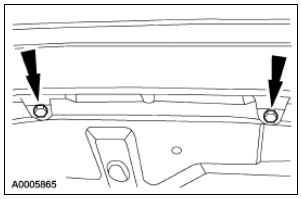
10. To install, reverse the removal procedure.

Bumper Cover Rear

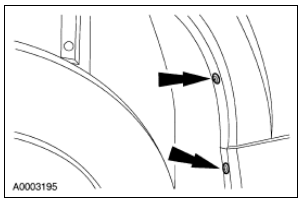
Removal and Installation

RH and LH Side

1. Remove the screws.

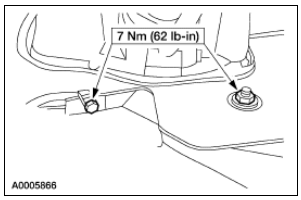


2. Remove the four inner fender screws.



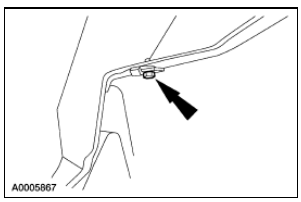
RH Side Only

3. Remove the rear bumper cover bolt and the nut located in the wheelwell area.



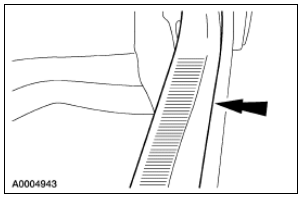
LH Side Only

4. Remove the rear bumper cover bolt.



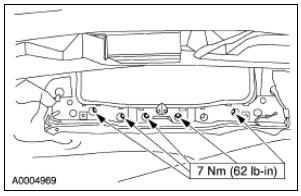
RH and LH Side

5. Remove the luggage compartment scuff plate.



6. Remove the luggage compartment back and side panel trim.

7. From the luggage compartment, remove the rear bumper cover nuts.



8. From the luggage compartment, remove the 10 rear bumper cover nuts (five each side).

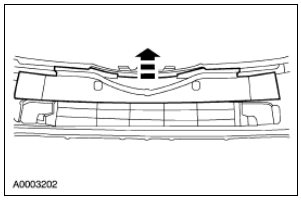
9. Remove the rear bumper cover.

10. To install, reverse the removal procedure.

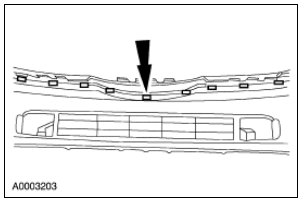
Bumper Cover Trim, Front

Removal and Installation

1. Remove the front bumper cover. For additional information, refer to Bumper Cover Front .
2. Remove the retaining clips and the poly foam.



3. Remove the retaining clips and the trim.

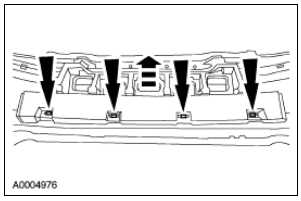


4. To install, reverse the removal procedure.

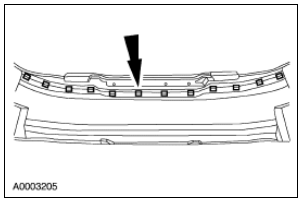
Bumper Cover Trim, Rear

Removal and Installation

1. Remove the rear bumper cover. For additional information, refer to Bumper Cover Rear .
2. Remove the retaining clips and the poly foam.



3. Remove the retaining clips and the trim.



4. To install, reverse the removal procedure.

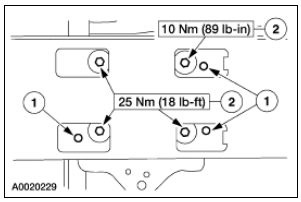
Bumper Front

Removal

1. Remove the front bumper cover. For additional information, refer to Bumper Cover Front in this section.

2. Disconnect the horn electrical connector.

3. Remove the front bumper.
    1. Drill out the six spot welds.
    2. Remove the eight bolts.



Installation

1. **NOTE:** Transfer the horns if required.

   NOTE: Spot welding the bumper is not required.

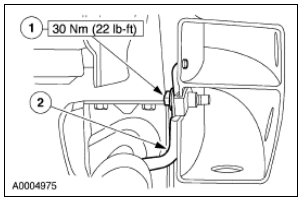
   To install, reverse the removal procedure.

Bumper Rear

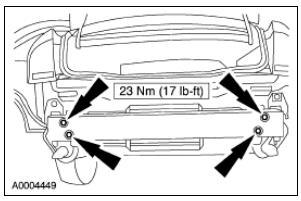
Removal and Installation

1. Remove the rear bumper cover. For additional information, refer to Bumper Cover Rear .

2. Remove the exhaust hanger bracket.
    1. Remove the bolt.
    2. Remove the bracket.



3. Remove the bolts and the rear bumper.



4. To install, reverse the removal procedure.

Part Replacement Chart Safety Belt With Damaged Weld Nut Anchor Plate Threads

Part Number	Description	Location
N808687 S190	Nut M10 x 1.5 x 8.6 hex flanged extrusion	Fr. D-ring
N802068 S424	Nut M10 x 1.5 hex flange locking	Fr. o/b
W701917 S309	Screw M10 x 1.5 x 21.5 T50 Torx, pia w/54602B82	Ht. adj
W705643 S409	Screw M10 x 1.5 x 18 hex flange shoulder, pia w/5461202, 3 pia w/seat kit	Fr. bkl
W700883 S409	Screw M10 x 1.5 T50 Torx, pia w/all retractors	Retr.
W704703 S408	Screw M10 1.5 x 34.0 pan head taping, pia w/54611B68, 54611B69	Rr D-ring
W700883 S409	Screw M10 x 1.5 T50 Torx	Rr o/b
N800937 S190	Nut-M10 x 1.75 hex flanged locking	Rr i/b

Torque Specifications

Description	Nm	lb-ft	lb-in
D-ring bolt	40	30	
D-ring nut	40	30	
Front safety belt anchor nut	40	30	
Front safety belt buckle bolt	40	30	
Front safety belt nut	40	30	
Height adjuster bolts	40	30	
Rear outboard safety belt nuts	40	30	
Rear safety belt anchor bolts	40	30	
Rear safety belt buckle bolt	48	35	
Rear seat bolster nut	11	8	
Retractor bolt	40	30	
Child safety seat tether anchor bolts	20	15	
Steering column opening reinforcement bolts	9		80
Instrument panel tunnel brace bolts	20	15	
Child safety seat tether anchor LATCH bolt	10		89

Safety Belt System

⚠ WARNING: All safety belt assemblies including retractors, buckles, front seat belt buckle support assemblies (slide bar), if equipped, shoulder belt height adjusters, if equipped, child safety seat tether bracket assemblies, if equipped, and attaching hardware should be inspected after any collision. All belt assemblies should be installed new unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected. New safety belt assemblies should be installed if either damage or incorrect operation in noted.

⚠ WARNING: Each seating position in the vehicle has a specific safety belt assembly which consists of one buckle and one tongue. The safety belt assembly is designed to be used as a pair and is not to be used across seating positions.

The active restraint system consists of:

- the front safety belt retractors with pretensioners secured to the body under the B-pillar lower trim panel.
- the rear LH and RH safety belt retractors secured to the body behind the quarter trim panels.
- the rear center safety belt retractor secured to the body under the package tray trim panel.
- the front inboard buckle end secured to the front seat assembly.
- the rear LH, RH, and center buckle ends secured to the rear floor pan under the rear seat cushion.
- the safety belt shoulder height adjuster, attached at the B-pillar under the trim panel.
- the child safety seat tether anchors attached to the package tray under the trim panel.
- the child safety seat LATCH system, attached to the floor pan under the second row seating.

A continuous-loop, single retractor active restraint system is used on both the front and rear seat safety belt assemblies.

Pretensioner System

The front safety belt and retractor assembly uses a pretensioner system which works in conjunction with the front air bag system mounted in the steering wheel and instrument panel. When the front air bag system is deployed, the pretensioner in the retractor deploys, causing the retractor spool to rotate. The rotating spool action removes excess webbing from the safety belt assembly, tightening the webbing around the occupant.

New driver and front passenger seat belt system (including belt and retractor assembly, buckles, and height adjusters) must be installed if the vehicle is involved in a collision that results in deployment of the front air bags and safety belt pretensioners.

For diagnostic information, refer to Section 501-20B .

For pretensioner retractor disposal information, refer to Section 501-20B .

Safety Belt, Lap/Shoulder

While the vehicle is in motion, the combination lap and shoulder belt adjusts to the occupant's movement. However, if the vehicle is braked hard, cornered hard or if the vehicle receives an impact of 8 km/h (5 mph) or more, the lap and shoulder belt locks and helps reduce the occupant's forward movement.

Safety Belt, Buckle End Front

The inboard front safety belt buckle end and outboard anchor is secured to the front seat. This allows the front safety belt buckle end and outboard anchor to move with the front seat.

Safety Belt, Lap/Shoulder Dual Locking Mode

⚠ WARNING: Rear-facing infant seats should never be placed in the front seats.

The dual locking mode retractor on the shoulder belt portion of the combination lap/shoulder safety belt for the front seat passenger and rear seat passengers operates in two ways:

1. In the vehicle-sensitive (emergency locking) mode, the shoulder belt retractor will allow the occupant freedom of movement, locking tight only on hard braking, hard cornering or impacts of approximately 8 km/h (5 mph) or more. The front and rear outboard safety belt retractors can also be made to lock by pulling/jerking on the belt.

2. In the automatic locking mode, the shoulder belt retractor will be automatically locked and remain locked when the combination lap/shoulder safety belt is buckled and does not allow the occupant freedom of movement. This mode provides tight lap/shoulder belt fit on the occupant and on a child safety seat or infant carrier installation restraint.

When the combination lap/shoulder belt is unbuckled and allowed to retract completely, the retractor will switch to the vehicle sensitive (emergency locking) mode.

The automatic locking mode must be used when installing a child safety seat.

Child Safety Seat Tether Anchors

Child safety seat tether anchors, located in the package tray, have been provided at all three rear seating positions. If a child safety seat was in use during a collision, inspect the tether anchor and all surrounding sheet metal for damage. Install a new tether anchor if necessary. Rework the sheet metal to its original condition and structural integrity. For additional information, refer to Child Safety Seat Tether Anchor .

Attaching Safety Seats With Tether Straps

Some manufacturers make child safety seats that include a tether strap that goes over the back of the vehicle seat and attaches to an anchoring point. Other manufacturers offer the tether strap as an accessory. Contact the manufacturer of the child safety seat for information about ordering a tether strap.

Lower Anchors and Tethers for CHildren (LATCH)

The Lower Anchors and Tethers for CHildren (LATCH) system is a standardized and uniform attachment system for installing child safety seats in passenger vehicles. LATCH-equipped child safety seats have two lower attachments that connect to the vehicle portion of the LATCH system.

The vehicle portion of the system consists of two brackets, with two attachment points (6 mm wires) welded to each bracket. The attachment points protrude from the biteline between the seat cushion and seat backrest of the second row seating.

If a child safety seat was in use during a collision, inspect the vehicle portion of the system for damage. If any of the attachment points (6 mm wires) are damaged, install a new LATCH bracket.

Safety Belt Warning System

The safety belt warning indicator illuminates and a chime sounds to remind the occupants to fasten their safety belts.

The conditions of operation for the safety belt warning indicator and chime are as follows:

- If the driver safety belt is not buckled before the ignition switch is turned to RUN, then the safety belt warning indicator illuminates for one to two minutes and the warning chime sounds for four to eight seconds.
- If the driver safety belt is buckled while the warning indicator is illuminated and the reminder chime is sounding, then the safety belt warning indicator and reminder chime turn off.
- If the driver safety belt is buckled before the ignition switch in turned to RUN, then the safety belt warning indicator and reminder chime remain off.

Belt Minder

The Belt Minder feature is a supplemental warning to the safety belt warning function. This feature provides additional reminders to the driver that the driver's safety belt is unbuckled by intermittently sounding a chime and illuminating the safety belt warning lamp in the instrument cluster.

To activate or deactivate the Belt Minder feature, refer to Section 413-09 .

If...	Then...
The driver's safety belt is not buckled before the vehicle has reached at least 5 km/h (3 mph) and 1-2 minutes have elapsed since the ignition switch has been turned to ON...	The Belt Minder feature is activated the safety belt warning light illuminates and the warning chime sounds for 6 seconds every 30 seconds, repeating for approximately 5 minutes or until the safety belt is buckled.
The driver's safety belt is buckled while the safety belt indicator light is illuminated and the safety belt warning chime is sounding...	The Belt Minder feature will not activate.
The driver's safety belt is buckled before the ignition switch is turned to the ON position...	The Belt Minder feature will not activate.

Safety Belt System

Inspection and Verification

1. Verify the customer's original concern by operating the active restraint system to duplicate the condition.

2. Inspect to determine if any of the following mechanical or electrical concerns apply:

Visual Inspection Chart

Mechanical	Electrical
• Inspect the safety belt webbing for integrity.	• Open fuse. • Bare, broken or disconnected wire. • Connector not tightly engaged. • Safety belt warning indicator lamp burned out or broken.

3. If the inspection reveals an obvious concern(s) that can be readily identified, repair the concern(s) as necessary.

4. If the concern remains after the inspection, determine the symptom. GO to Symptom Chart .

Symptom Chart

Symptom Chart

Component Test

Functional Test

1. **NOTE:** If the RH or the rear safety belts are to be tested, a passenger must be used.

   Fasten the safety belts and proceed to a safe area.

2. Attain a speed of 8 km/h (5 mph).

3. ⚠ **WARNING: The driver and passenger must be prepared to brace themselves if the retractor does not lock.**

   Test the safety belts.

1. Grasp the shoulder harness and prepare to lean forward.
2. Make maximum brake application without a skid.
3. NOTE: Do not jerk on the safety belt webbing when carrying out this test. Lean forward slightly when the brake application is made.

4. The safety belts should lock up with minimum webbing extension.

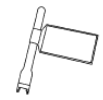
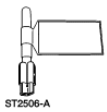
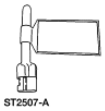
5. If there is a lockup of both shoulder straps, the safety belt assemblies are functioning correctly. Should either or both retractors fail to lock up at the 8 km/h (5 mph) speed, repeat the test at a constant 24 km/h (15 mph) speed. (This test must be carried out with a RH front or rear passenger if the RH front or rear outboard safety belts are to be tested).

6. **NOTE:** If either or both the shoulder belts do not lock up, the sheet metal in the retractor's mounting surface may need to be returned to its original shape and structural integrity.

   If either or both shoulder belts do not lock up at the 24 km/h (15 mph) test, replace the suspect retractor with a new retractor.

Supplemental Restraint System (SRS) Deactivation and Reactivation

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F395
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Deactivation

⚠ WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

⚠ WARNING: The safety belt buckle pretensioner and safety belt retractor pretensioner are pyrotechnic devices. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

⚠ WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

⚠ WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.**

NOTE: Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors.

NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road.**

NOTE: After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

1. ⚠ **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

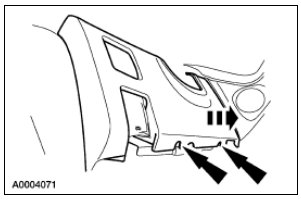
   Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

   The side air bag sensors are located at or near the base of the B-pillar.

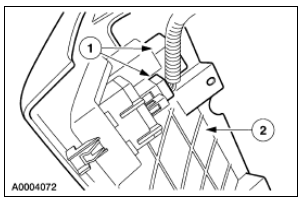
   To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

   Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

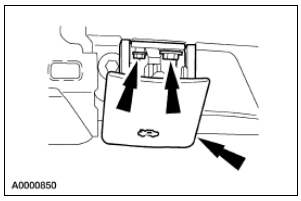
2. Remove the two screws and pull out on the lower steering column opening finish panel enough to access the electrical connectors.



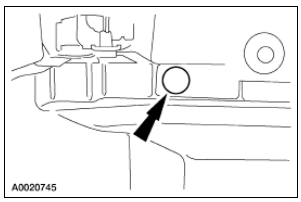
3. Remove the lower steering column opening finish panel.
   1. Disconnect the electrical connectors.
   2. Remove the lower steering column opening finish panel.



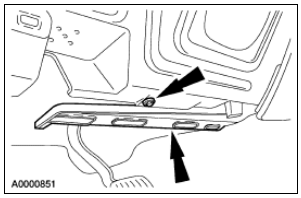
4. Remove the screws. Separate the hood latch release cable and handle assembly from the steering column opening reinforcement.



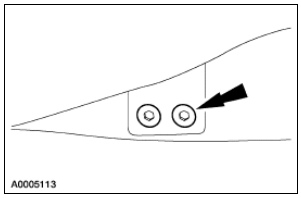
5. Remove the two pin-type retainers and the RH instrument panel insulator.
   - Disconnect the courtesy lamp.



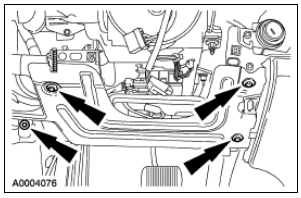
6. Remove the screw and the heater duct.



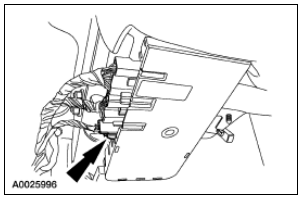
7. Loosen the two driver-side instrument panel tunnel brace bolts.
   - Position the carpet aside to gain access to the bolts.



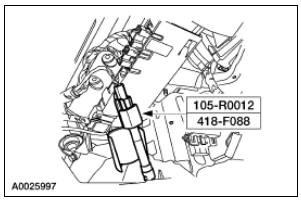
8. Remove the screws and the steering column opening reinforcement.



9. Disconnect the clockspring electrical connector at the base of the steering column.

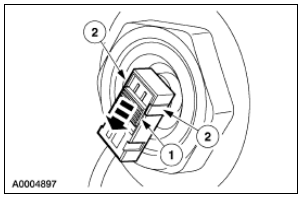


10. Attach the restraint system diagnostic tool to the vehicle harness side of the clockspring electrical connector.

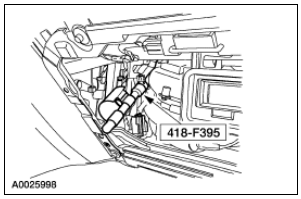


11. Remove the glove compartment. For additional information, refer to Section 501-12 .

12. Disconnect the passenger air bag module electrical connector.
    1. Reaching into the glove box opening toward the center of the instrument panel, under the cross-car beam, slide and disengage the passenger air bag module electrical connector locking clip.
    2. Push in on the two release tabs and disconnect the passenger air bag module electrical connector.



13. Attach the restraint system diagnostic tool to the vehicle harness side of the passenger air bag electrical connector.



14. Connect the battery ground cable. For additional information, refer to Section 414-01 .

15. Move and tilt the front seats to their highest and most forward position.

16. ⚠ **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

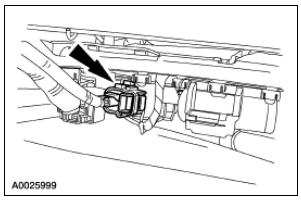
    Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

    The side air bag sensors are located at or near the base of the B-pillar.

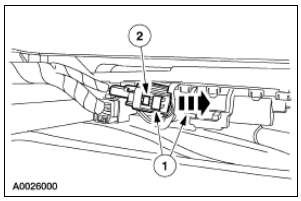
    To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

    Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

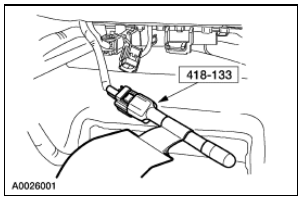
17. From under the passenger seat, release the tab on the connector bracket and remove the passenger seat side air bag electrical connector.



18. Disconnect the passenger seat side air bag electrical connector.
    1. Slide and disengage the passenger seat side air bag electrical connector locking clip.
    2. Push in to release the tab and disconnect the passenger seat side air bag electrical connector.



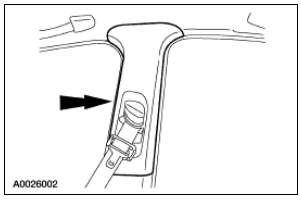
19. Attach the restraint system diagnostic tool to the passenger seat side air bag floor electrical connector.



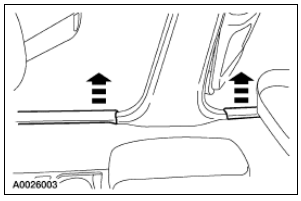
20. Remove the passenger side B-pillar weatherstripping.

21. Position the safety belt D-ring to its highest point.

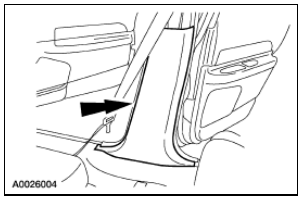
22. Remove the passenger side B-pillar upper trim panel.



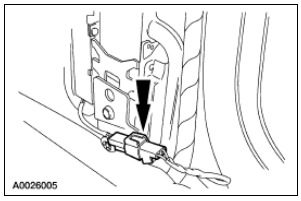
23. Remove the passenger side front and rear door scuff plates.



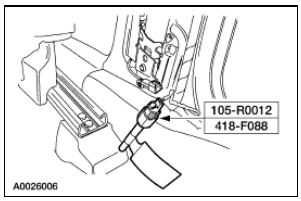
24. Remove the passenger side B-pillar lower trim panel.



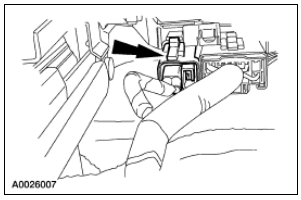
25. Disconnect the passenger side safety belt retractor pretensioner floor electrical connector.



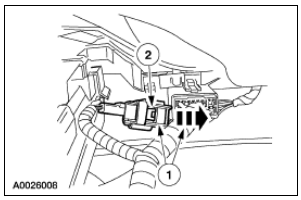
26. Attach the restraint system diagnostic tool to the passenger side safety belt retractor pretensioner floor electrical connector.



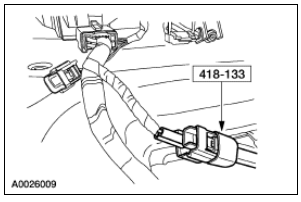
27. From under the driver seat, release the tab on the connector bracket and remove the driver seat side air bag electrical connector.



28. Disconnect the driver seat side air bag electrical connector.
    1. Slide and disengage the driver seat side air bag electrical connector locking clip.
    2. Push down to release the tab and disconnect the driver seat side air bag electrical connector.



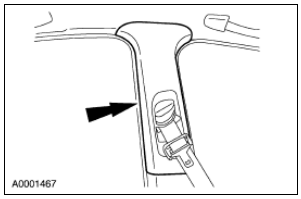
29. Attach the restraint system diagnostic tool to the driver seat side air bag floor electrical connector.



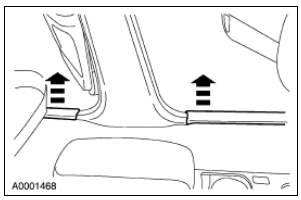
30. Remove the driver side B-pillar weatherstripping.

31. Position the safety belt D-ring to its highest point.

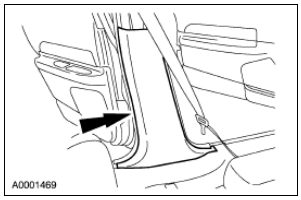
32. Remove the driver side B-pillar upper trim panel.



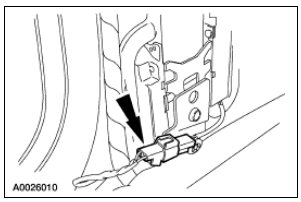
33. Remove the driver side front and rear door scuff plates.



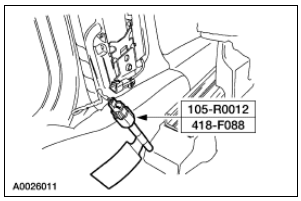
34. Remove the driver side B-pillar lower trim panel.



35. Disconnect the driver side safety belt retractor pretensioner electrical connector.



36. Attach the restraint system diagnostic tool to the driver side safety belt retractor pretensioner floor electrical connector.



37. Connect the battery ground cable. For additional information, refer to Section 414-01 .

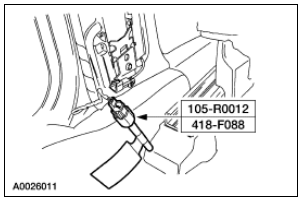
38. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

39. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

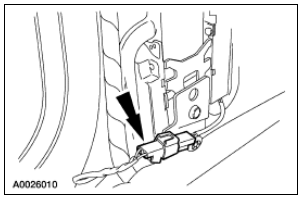
Reactivation

⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings and notes at the beginning of the deactivation procedure.

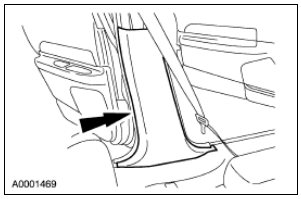
1. Remove the restraint system diagnostic tool from the driver side safety belt retractor pretensioner floor electrical connector.



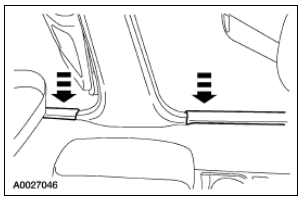
2. Connect the driver side safety belt retractor pretensioner electrical connector.



3. Install the driver side B-pillar lower trim panel.

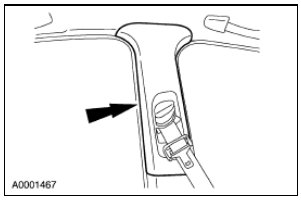


4. Install the driver side front and rear door scuff plates.



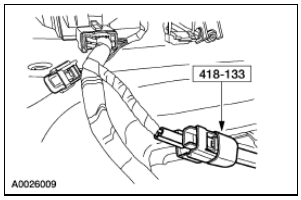
5. **NOTE:** Position the safety belt D-ring to its highest point.

   Install the driver side B-pillar upper trim panel.

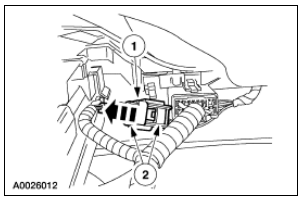


6. Install the driver side B-pillar weatherstripping.

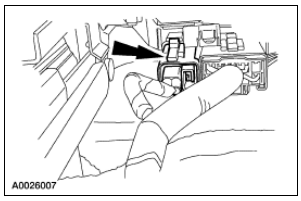
7. Remove the restraint system diagnostic tool from the driver seat side air bag floor electrical connector.



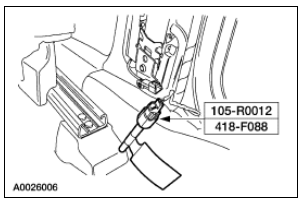
8. Connect the driver seat side air bag electrical connector.
    1. Connect the driver seat side air bag electrical connector.
    2. Slide and engage the driver seat side air bag electrical connector locking clip.



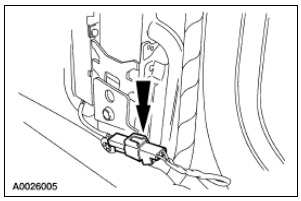
9. Install the driver seat side air bag electrical connector onto the connector bracket under the driver seat.



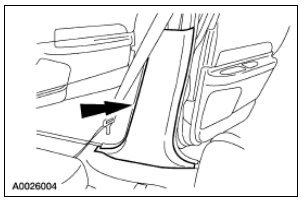
10. Remove the restraint system diagnostic tool from the passenger side safety belt retractor pretensioner electrical connector.



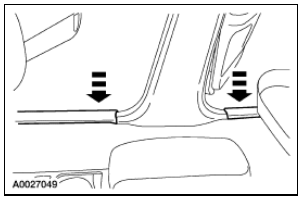
11. Connect the passenger side safety belt retractor pretensioner electrical connector.



12. Install the passenger side B-pillar lower trim panel.

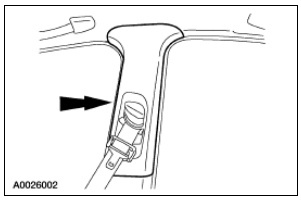


13. Install the passenger side front and rear door scuff plates.



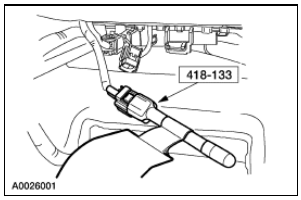
14. **NOTE:** Position the safety belt D-ring to its highest point.

    Install the passenger side B-pillar upper trim panel.

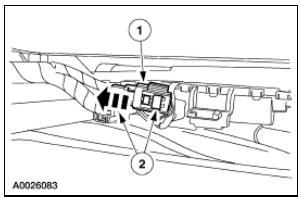


15. Install the passenger side B-pillar weatherstripping.

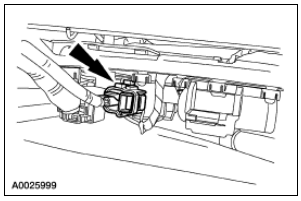
16. Remove the restraint system diagnostic tool from the passenger seat side air bag floor electrical connector.



17. Connect the passenger seat side air bag electrical connector.
    1. Connect the passenger seat side air bag electrical connector.
    2. Slide and engage the passenger seat side air bag electrical connector locking clip.



18. Install the passenger seat side air bag electrical connector onto the connector bracket under the passenger seat.



19. Connect the battery ground cable. For additional information, refer to Section 414-01 .

20. Position the front seats rearward.

21. ⚠ **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag**

supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

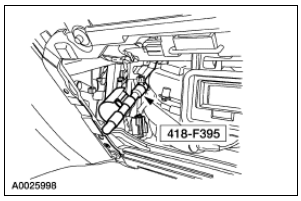
Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

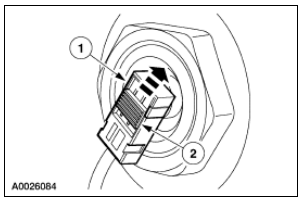
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

22. Remove the restraint system diagnostic tool from the vehicle harness side of the passenger air bag electrical connector.

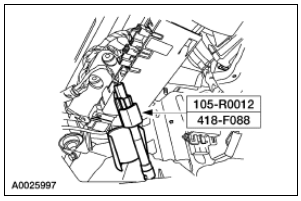


23. Connect the passenger air bag module electrical connector.
    1. Reach into the glove box opening toward the center of the instrument panel, under the cross-car beam and connect the passenger air bag module electrical connector.
    2. Slide and engage the passenger air bag module electrical connector locking clip.

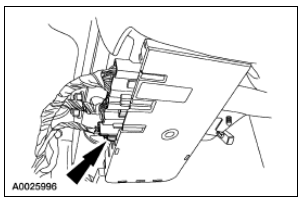


24. Install the glove compartment. For additional information, refer to Section 501-12 .

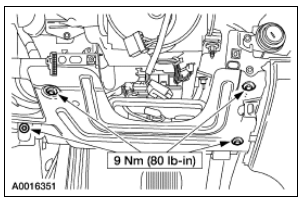
25. Remove the restraint system diagnostic tool from the vehicle harness side of the clockspring electrical connector.



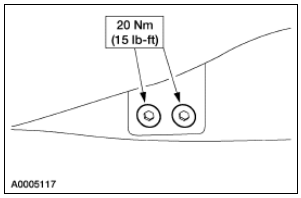
26. Connect the clockspring electrical connector at the base of the steering column.



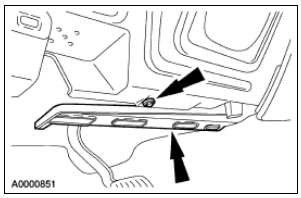
27. Position the steering column opening reinforcement and install the screws.



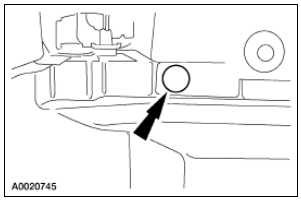
28. Tighten the two driver-side instrument panel tunnel brace bolts.
    - Reposition the carpet.



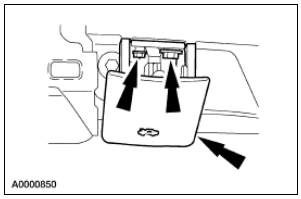
29. Position the heater duct and install the screw.



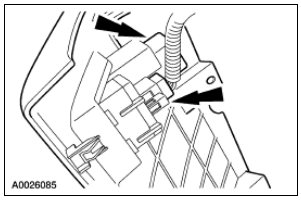
30. Install the RH instrument panel insulator and the two pin-type retainers.
    - Connect the courtesy lamp.



31. Position the hood latch release cable and handle assembly to the steering column opening reinforcement and install the screws.

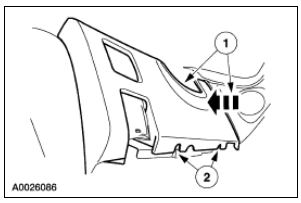


32. Connect the electrical connectors to the switches in the lower steering column opening finish panel.



33. Install the lower steering column opening finish panel to the instrument panel.

1. Position the lower steering column opening finish panel to the instrument panel and push in, seating the retaining clips.
2. Install the screws.



34. Connect the battery ground cable. For additional information, refer to Section 414-01 .

35. **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

36. Check the active restraint system for correct operation. For additional information, refer to Safety Belt System in the Diagnosis and testing portion of this section.

Safety Belt Cleaning

1. ⚠ **WARNING: Do not bleach or re-dye the webbing, as the webbing may weaken.**

   Clean the safety belt webbing only with a mild soap solution recommended for cleaning upholstery or carpets. Follow the instructions provided with the soap.

Safety Belt Maintenance

⚠ WARNING: All safety belt assemblies include retractors, buckles, front seat belt buckle support assemblies (slide bar), if equipped, shoulder belt height adjuster, if equipped, child safety seat tether bracket assemblies, if equipped, and attaching hardware should be inspected after any collision. All belt assemblies should be installed new unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected. New safety belt assemblies should be installed if either damage or incorrect operation is noted.

1. The safety belt assemblies should be periodically inspected to make sure that they have not become damaged and that they remain in correct operating condition, particularly if they have been subjected to severe stress.

2. Before installing the new safety belt assembly; the safety belt retaining areas must be inspected for damage and distortion. If the retaining points are damaged and distorted, the sheet metal must be reworked back to its original shape and structural integrity.

3. Install the new safety belt(s) using the appropriate instructions. Carry out the Functional Test Procedure. For additional information, refer to Safety Belt System in this section.

Replacement of the Weld Nut and Reinforcement

1. **NOTE:** If the safety belt anchor nuts or reinforcements are stripped or missing, a new nut/reinforcement plate must be installed.

   Expose the suspect anchor point.

2. Drill out two 8 mm (5/16 inch) diameter access holes adjacent to the weld nut clearance hole.

3. Thread a length of copper welding wire through the clearance hole and position to secure the weld nut and washer.

4. Use MIG wire feed welder and plug weld a M10 weld nut and standard washer in place at the two 8 mm (5/16 inch) holes.

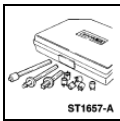
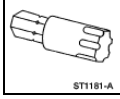
5. Metal finish as necessary.

6. Install the restraint system.

7. Carry out the Functional Test. For additional information, refer to Safety Belt System in this section.

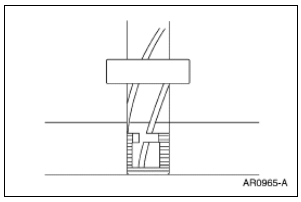
Safety Belt Shoulder Height Adjuster With Stripped Weld Nuts

Special Tool(s)

 ST1657-A	D-Ring Installation Kit 100-F012 (134-00018) or equivalent
 ST1181-A	Safety Belt Bolt Bit 501-010 (T77L-2100-A) or equivalent

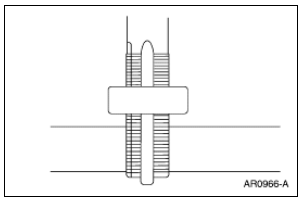
1. Remove the shoulder safety belt height adjuster. For additional information, refer to Height Adjuster Front Shoulder Safety Belt in this section.

2. Use the half-inch drill provided in the D-Ring Installation Kit to drill out the damaged threads in the upper pillar structure.

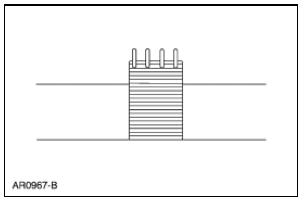

AR0965-A

3. **NOTE:** After each rotation, back off the tap slightly to remove the new cuttings and be sure to blow out any chips before proceeding.

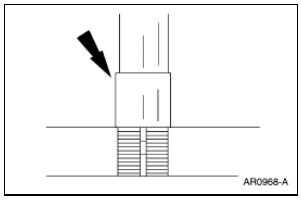
   Apply a suitable lubricant to the M14x1.5 tap provided in the D-Ring Installation Kit and tap new threads.


AR0966-A

4. Use a threaded insert (Part of #N807170-S190) provided in the D-Ring Installation Kit and screw it into the retapped hole until it is slightly below the surface.

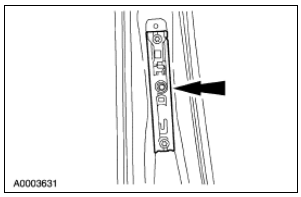

AR0967-B

5. Use a hammer to lightly tap the installation tool provided in the D-Ring Installation Kit several times to seat the insert keys.

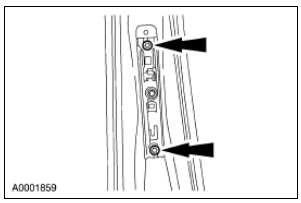


6. **NOTE:** If the shoulder safety belt height adjuster bolts are stripped, install a new height adjuster.

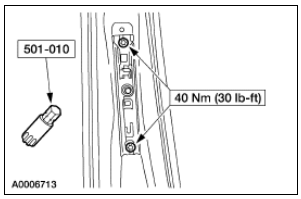
   Insert the shoulder safety belt height adjuster in the opening of the upper B-pillar structure, making sure the shoulder belt height adjuster knob on the shoulder safety belt height adjuster is positioned above the D-ring attachment nut. (The tab is located at the top and is to be inserted in the hole provided in the B-pillar structure).



7. Hand tighten the height adjuster bolts until they are snug.

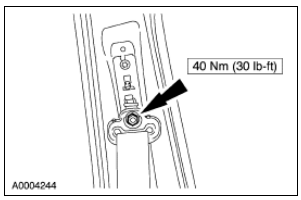


8. Using the special tool, tighten the height adjuster bolts.



9. **NOTE:** Make sure the D-ring rotates freely.

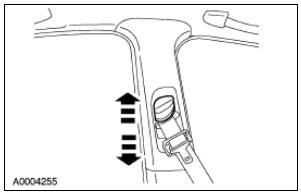
   Install the safety belt D-ring and tighten the nut.



10. **NOTE:** Position the safety belt D-ring to its highest point before installing B-pillar trim.

    Install the B-pillar trim.

11. Operate the front seat shoulder strap adjuster. Make sure it travels from top to bottom and locks correctly in each position.



12. Check the restraint system for correct operation.

Safety Belt Procedure After a Collision

⚠ WARNING: All safety belt assemblies include retractors, buckles, front seat belt buckle support assemblies (slide bar), if equipped, shoulder belt height adjuster, if equipped, child safety seat tether bracket assemblies, if equipped, and attaching hardware should be inspected after any collision. All belt assemblies should be installed new unless a qualified technician finds the assemblies show no damage and operate correctly. Belt assemblies not in use during a collision should also be inspected. New safety belt assemblies should be installed if either damage or incorrect operation is noted.

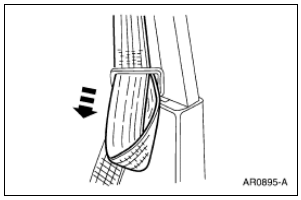
NOTE: The driver and front passenger seat belt system (including belt and retractor assembly, buckles, and height adjusters) must be replaced if the vehicle is involved in a collision that results in deployment of the front air bags and safety belt pretensioners.

1. Before installing a new safety belt assembly, the safety belt attaching areas must be inspected for damage and distortion. If the attaching points are damaged and distorted, the sheet metal must be worked back to its original shape and structural integrity.

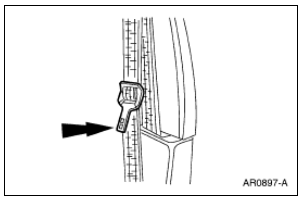
2. Install the new safety belt(s). For additional information, refer to the procedure in this section. Carry out the Functional Test. For additional information, refer to Safety Belt System in this section.

Safety Belt Tongue Rotated on Belt

1. Grasp the belt tongue and pull the belt webbing down to form a loop through the slot in the tongue.

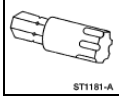


2. Rotate and fold the belt webbing over itself within the slot to remove the twist.
3. Pull the excess belt webbing back through the slot in the belt tongue.
4. Pull the excess belt webbing through the slot.
5. The safety belt tongue should face inward when completed.



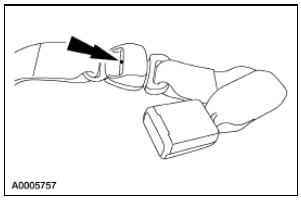
Retractor Rear Center Safety Belt

Special Tool(s)

 ST1181-A	Safety Belt Bolt Bit 501-010 (T77L-2100-A)

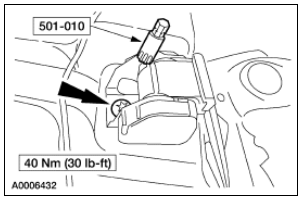
Removal

1. Using a suitable tool, release the mini-buckle.


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2. Remove the retractor cover.

3. Using the special tool, remove the retractor.

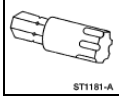


Installation

1. To install, reverse the removal procedure.
   - Check the restraint system for correct operation.

Retractor Rear LH and RH Safety Belt

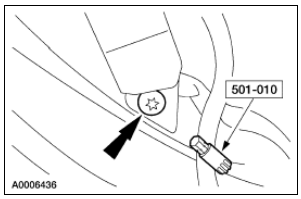
Special Tool(s)

 ST1181-A	Safety Belt Bolt Bit 501-010 (T77L-2100-A)

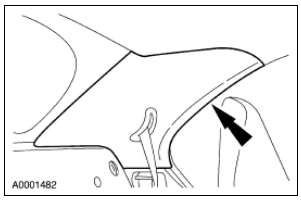
Removal

1. Remove the seat backrest rear side bolsters. For additional information, refer to Section 501-10 .

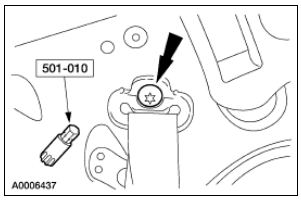
2. Using the special tool, remove the rear safety belt anchor bolt.



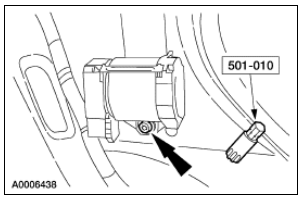
3. Remove the quarter trim panel.



4. Using the special tool, remove the D-ring bolt.

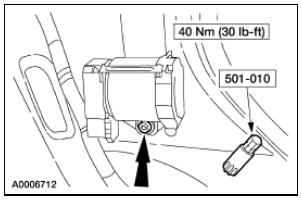


5. Using the special tool, remove the bolt and the retractor.

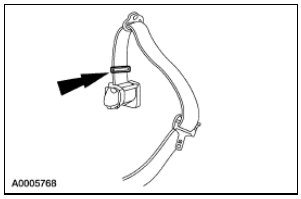


Installation

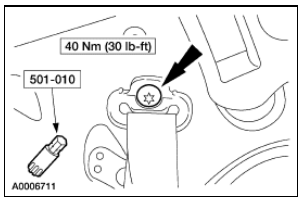
1. Using the special tool, install the retractor.



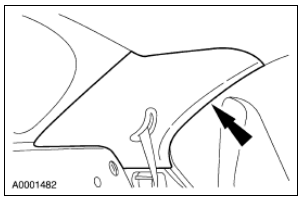
2. Remove the shipping clip from the safety belt webbing.



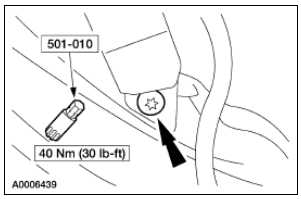
3. Using the special tool, install the D-ring bolt.



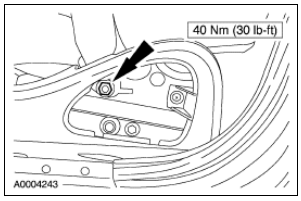
4. Install the rear quarter trim panel.



5. Using the special tool, install the rear safety belt anchor bolt.



6. Install the seat backrest rear side bolsters. For additional information, refer to Section 501-10 .



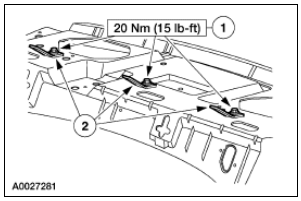
7. Check the restraint system for correct operation.

Child Safety Seat Tether Anchor

Removal and Installation

1. Remove the package tray trim panel. For additional information, refer to Section 501-05 .

2. Remove the child safety seat tether anchors.
    1. Remove the bolts.
    2. Remove the child safety seat tether anchors.



3. ⚠ **WARNING: It is important that the bolt/anchor be securely tightened to specification. Otherwise, the child's safety seat may not be properly secured, and the child could be injured in case of a sudden stop or accident.**

   NOTE: Rework the sheet metal to its original condition and structural integrity.

   NOTE: Make sure to tighten the bolts to specification.

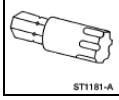
   To install, reverse the removal procedure.

   - See the removal procedure or Specifications for torque specifications.

4. Check the active restraint system for correct operation.

Height Adjuster Front Shoulder Safety Belt

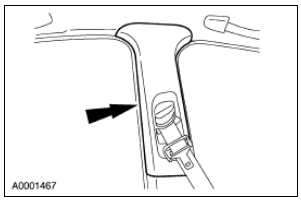
Special Tool(s)

 ST1181-A	Safety Belt Bolt Bit 501-010 (T77L-2100-A)

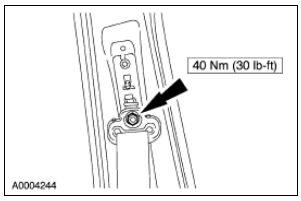
Removal and Installation

1. Pull back the weather-strip surrounding the upper B-pillar trim.
2. **NOTE:** Position the safety belt D-ring to its highest point.

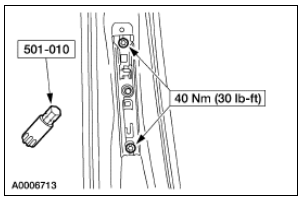
   Remove the upper B-pillar trim.



3. Remove the D-ring nut.



4. Using the special tool, remove the height adjuster bolts.



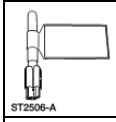
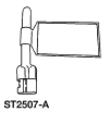
5. **NOTE:** Position the safety belt D-ring to its highest point.

   To install, reverse the removal procedure.

   - Check the restraint system for correct operation.

Safety Belt Buckle Front

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F395
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Removal

⚠ WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface could contain deposits of sodium hydroxide, a product of the gas gernerant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so could result in air bag deployment which could result in personal injury.

All vehicles

1. Prepare the vehicle for seat removal.
    1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

       Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

       The side air bag sensors are located at or near the base of the B-pillar.

       To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

       Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .
    2. **⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system**

deactivation/reactivation procedure.

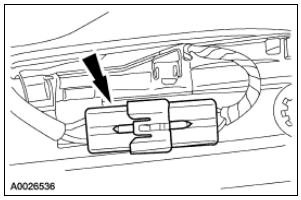
Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section.

3. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the seat removal and installation procedure.**

   Remove the seat on the side with the affected safety belt buckle. For additional information, refer to Section 501-10 .

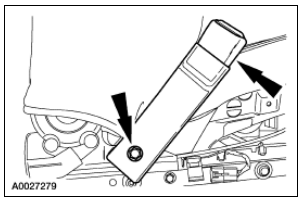
Driver seat only

2. Disconnect the safety belt buckle usage detection switch electrical connector.



All front safety belt buckles

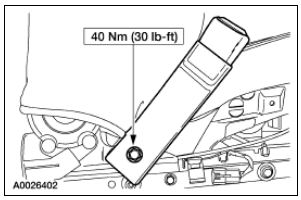
3. Remove the bolt and the safety belt buckle.



Installation

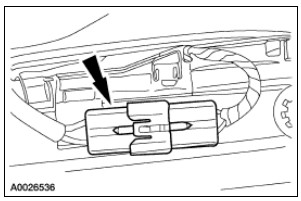
All front safety belt buckles

1. Position the safety belt buckle to the seat. Install the bolt.



Driver seat only

2. Connect the safety belt buckle usage detection switch electrical connector.



All vehicles

3. Restore the vehicle to operating condition.
    1. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the seat removal and installation procedure.**

       Install the seat with the affected safety belt buckle. For additional information, refer to Section 501-10 .
    2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

       Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section.
    3. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

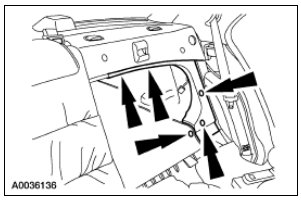
       With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .
    4. Check the active restraint system for correct operation. For additional information, refer to Safety Belt System in this section.

Child Safety Seat Tether Anchor LATCH

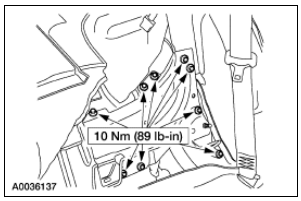
Removal and Installation

NOTE: The left-hand side is shown, the right-hand side is similar.

1. Remove the rear seat backrest side bolster. For additional information, refer to Section 501-10 .
2. Remove the rear seatback. For additional information, refer to Section 501-10 .
3. Remove the five pin-type retainers (three shown) and remove the finish panel.



4. Remove the bolts and the LATCH bracket.



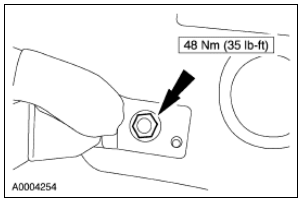
5. To install, reverse the removal procedure.
   - Make sure the wire harness is positioned correctly before installing the LATCH bracket.

Safety Belt Buckle Rear

Removal and Installation

1. Remove the rear seat cushion. For additional information, refer to Section 501-10 .

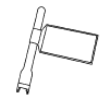
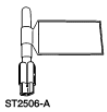
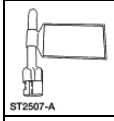
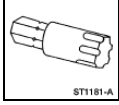
2. Remove the nut and the rear safety belt buckle.



3. To install, reverse the removal procedure.
   - Check the restraint system for correct operation.

Safety Belt Retractor and Pretensioner

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F395
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)
 ST1181-A	Safety Belt Bolt Bit 501-010 (T77L-2100-A)

Removal

⚠ WARNING: The safety belt buckle pretensioner and safety belt retractor pretensioner are pyrotechnic devices. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner.

⚠ WARNING: The safety belt buckle pretensioner and safety belt retractor pretensioner are pyrotechnic devices. Never probe an electrical connector pretensioner. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

⚠ WARNING: After deployment, the air bag surface could contain deposits of sodium hydroxide, a product of the gas gernerant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so could result in air bag deployment which could result in personal injury.

NOTE: The driver side is shown, the passenger side is similar.

1. Prepare the vehicle for safety belt retractor and pretensioner removal.
    1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

       Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

       The side air bag sensors are located at or near the base of the B-pillar.

       To deplete the backup power supply energy, disconnect the battery ground cable and

wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

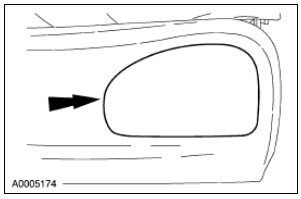
Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

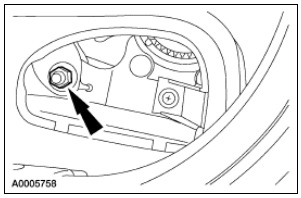
   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section.

2. ⚠ **CAUTION: Do not use a screwdriver to remove the safety belt cover.**

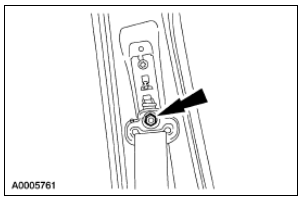
Remove the front safety belt anchor cover by placing fingers behind the cover and pushing outward.



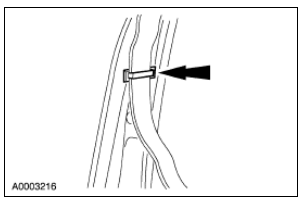
3. Remove the nut and the front safety belt anchor.



4. Remove the D-ring nut and route the safety belt out of the B-pillar trim panel.



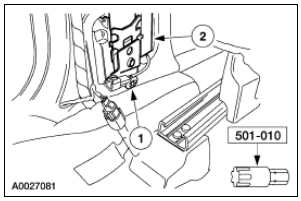
5. Remove the web guide.



6. **NOTE:** For pretensioner retractor disposal procedure, refer to Section 501-20B .

   Remove the safety belt retractor and pretensioner assembly.

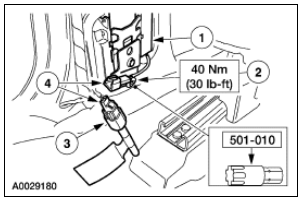
   1. Using the special tool, remove the bolt.
   2. Remove the safety belt retractor and pretensioner.



Installation

⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

1. Install the safety belt retractor and pretensioner assembly.
    1. Position the safety belt retractor and pretensioner.
    2. Using the special tool, install the bolt.
    3. Remove the restraint system diagnostic tool from the driver side safety belt retractor pretensioner electrical connector.
    4. Connect the electrical connector.



2. Connect the battery ground cable. For additional information, refer to Section 414-01 .

3. With the restraint system diagnostic tools still installed at the remaining deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

4. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

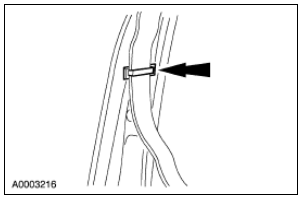
   Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

   The side air bag sensors are located at or near the base of the B-pillar.

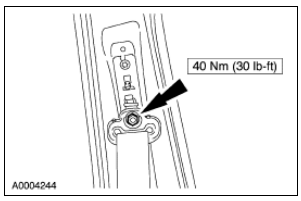
   To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

   Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

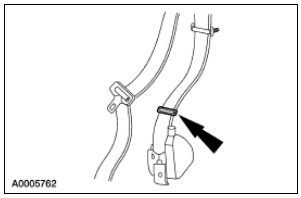
5. Install the web guide.



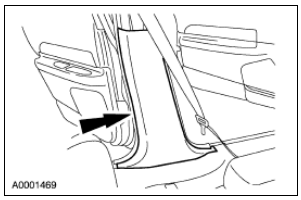
6. Install the D-ring and nut.



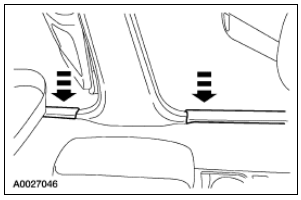
7. Remove the shipping clip from the safety belt webbing.



8. Install the B-pillar lower trim panel.

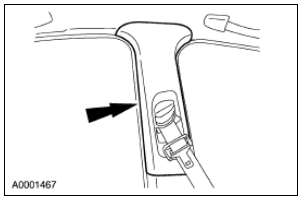


9. Install the driver side front and rear door scuff plates.

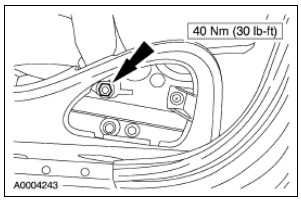


10. **NOTE:** Position the D-ring to its highest point.

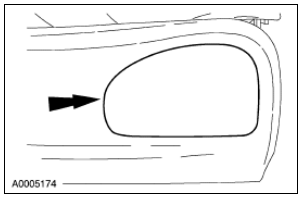
    Route the safety belt through the B-pillar upper trim panel. Install the upper B-pillar trim panel.



11. Position the front safety belt anchor and install the nut.



12. Install the front safety belt anchor cover.



13. Restore the vehicle to operating condition.
    1. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

       Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section.
    2. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

       With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .
    3. Check the active restraint system for correct operation. For additional information, refer to Safety Belt System .

Torque Specifications

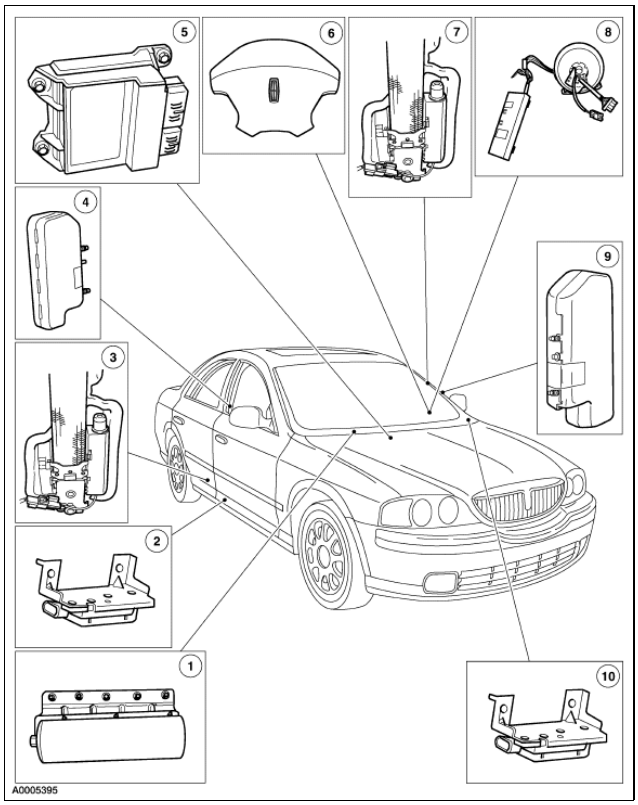
Description	Nm	lb-ft	lb-in
Passenger air bag module retaining nuts and bolts	9		80
Restraints control module (RCM) retaining bolts	12	9	
Side impact sensor retaining bolts	12	9	
Steering column retaining bolts	17	13	
Driver air bag module retaining bolts	12	9	
Side air bag module retaining bolts	9		80
Weld nut repair grounding screw (8 mm) (N802455-S190)	12	9	
Grounding screw (6 mm) (N806327-S190)	12	9	

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

The air bag supplemental restraint system (SRS) is designed to provide increased collision protection for front seat occupants in addition to that provided by the three-point safety belt system. Safety belt use is necessary to obtain the best occupant protection and to receive the full advantages of the SRS.

The air bag supplemental restraint system (SRS) components are shown in the following illustration.

Air Bag Supplemental Restraint System (SRS) Components



Item	Part Number	Description
1	044A74	Passenger air bag module
2	14B345	Side impact sensor (RH)
3	611B08	Belt retractor pretensioner, passenger
4	611D10	Passenger side air bag module
5	14B321	Restraints control module (RCM)
6	043B13	Driver air bag module
7	611B09	Belt retractor pretensioner, driver
8	14A664	Clockspring
9	611D11	Driver side air bag module
10	14B345	Side impact sensor (LH)

Driver Air Bag Module

NOTE: References to the driver air bag module must not be confused with the seat-mounted air bag components of the supplemental restraint system (SRS).

The driver air bag module:

- is steering wheel mounted.
- will deploy upon receiving a signal from the RCM.
- has no subassemblies.

Clockspring

The clockspring:

- is mounted on the steering column, behind the steering wheel.
- provides a continuous electrical path from the driver air bag module to the restraints control module (RCM).

Driver Seat Side Air Bag Module

NOTE: References to side air bag modules refer to the seat-mounted and not to the steering wheel or instrument panel mounted air bag components of the supplemental restraint system (SRS).

The driver seat side air bag module:

- is installed as an assembly.
- is mounted in the driver seat back.

Passenger Seat Side Air Bag Module

NOTE: References to side air bag modules refer to the seat-mounted and not to the steering wheel or instrument panel mounted air bag components of the supplemental restraint system (SRS).

The passenger seat side air bag module:

- is installed as an assembly.
- is mounted in the passenger seat back.

Passenger Air Bag Module

NOTE: References to the passenger air bag module must not be confused with the seat-mounted air bag components of the supplemental restraint system (SRS).

The passenger air bag module:

- is installed as an assembly.
- is mounted in the passenger side of the instrument panel.

Safety Belt Pretensioners

As part of the supplemental restraint system (SRS), the safety belt retractors are equipped with pretensioners. The safety belt retractor pretensioners rotate the safety belt retractors to remove excess slack from the safety belt webbing. The pretensioners are activated by the restraints control module (RCM) when the module detects a crash event force exceeding a programmed limit.

Restraints Control Module (RCM)

The restraints control module (RCM) is mounted on the center tunnel under the instrument panel. The RCM performs the following functions:

- signals the inflators to deploy the air bags in the event of a deployable crash.
- activates the belt retractor pretensioners to remove slack from the safety belt webbing.
- monitors the air bag supplemental restraint system (SRS) for faults.
- illuminates the air bag indicator if a fault is detected.
- flashes the air bag indicator to indicate the lamp fault code (LFC) detected.
- communicates the current or historical diagnostic trouble codes (DTCs) through the data link connector (DLC).
- signals the instrument cluster to activate a chime if the air bag indicator is not available and another SRS fault exists.
- contains an internal safing sensor which is not serviced separately.

The RCM monitors the SRS for possible faults. If a fault is detected while the ignition switch is in the RUN position, the RCM will illuminate the air bag indicator located in the instrument cluster.

When the ignition is cycled (turned off and then on), the air bag indicator will remain lit for six seconds and then go out. If an SRS fault exists, the air bag indicator will then flash the two-digit LFC associated with that fault. The air bag indicator will flash the LFC five times, then remain illuminated for the rest of the key cycle. The RCM will also communicate the current and historical DTCs through the data link connector (DLC), using the New Generation Star (NGS) Tester. If the air bag indicator does not function, and the system detects a fault condition, the RCM will signal the instrument cluster to activate an audible chime. The chime is a series of five sets of five tone bursts. If the chime is heard, the SRS and the air bag indicator require repair.

LFCs are prioritized. If two or more faults occur at the same time, the fault having the highest priority will be displayed first. After that fault has been corrected, the next highest priority fault will be displayed.

The RCM includes a backup power supply. This feature provides sufficient backup power to deploy the air bags and belt retractor pretensioners in the event that the ignition circuit is damaged in a collision before the safing and air bag sensors determine that an air bag deployment is required. The backup power supply will deplete its stored energy approximately one minute after the battery ground cable is disconnected.

Electrical System

The electrical system that supports the air bag supplemental restraint system (SRS):

- is powered from the battery through the ignition circuit.
- provides the electrical path from the restraints control module (RCM) to the SRS components.
- provides the electrical path from the RCM to the air bag indicator.
- provides the electrical path from the RCM to the data link connector (DLC).
- provides the electrical path from the RCM to the instrument cluster.

Sensors

⚠ WARNING: The restraints control module (RCM) orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) has been involved in a collision in which the center tunnel area has been damaged, inspect the mounting and bracket for deformation. If damaged, the RCM must be replaced whether or not the air bags have deployed. In addition, make sure the area of the RCM mounting is restored to its original production configuration.

⚠ CAUTION: Sensors are repaired by replacement only. Do not attempt to determine whether a sensor is OK. Always replace the sensor even if it does not appear to be damaged.

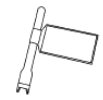
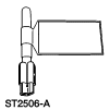
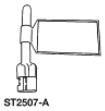
For this vehicle the SRS employs four impact sensors. Two of the sensors are integral to the RCM and are not separately serviceable. In addition, there are two side impact sensors located at the base of the B-pillars. The RCM is mounted on the center tunnel under the instrument panel. Mounting orientation is critical for correct operation of all impact sensors.

Vehicle Emergency Messaging Subsystem (VEMS)

The vehicle emergency messaging subsystem (VEMS) is provided as an output by the restraints control module (RCM). The VEMS output provides notification to the remote emergency satellite cellular unit (RESCU) module that the supplemental restraints system (SRS) has attempted to deploy all or parts of the SRS. For additional information, refer to Section 419-05 .

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Restraint System Diagnostic Tool Warning

⚠ WARNING: This tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

Diagnosing Customer Concerns Without Hard Diagnostic Trouble Codes (DTCs)

If a lamp fault code (LFC) is reported by the customer but is not present when the vehicle comes in for repair, follow the Diagnostic Instructions procedure in this section to identify the intermittent diagnostic trouble code (DTC).

Once the DTC is known, read the Normal Operation section for the code involved.

- Follow the deactivation procedure in this section.
- Determine the location of components involved in creating that code.
- Carry out a thorough visual inspection of:
  - components.
  - connectors.
  - splices and wiring harnesses.
  - pinched wires.
  - worn insulation on conductors.
  - opens, shorts or loosely mounted sensors.

Refer to Possible Causes, which lists the common concerns that relate to a particular code. Concerns are listed according to priority.

Diagnosing Customer Concerns with Hard Diagnostic Trouble Codes (DTCs)

Most air bag supplemental restraint system (SRS) diagnostic procedures will require the use of the deactivation and reactivation procedures in this section.

The deactivation and reactivation require the installation and removal of restraint system diagnostic tools. These procedures require removal of driver air bag module, and the disconnection of the passenger air bag

module, driver side air bag module, passenger side air bag module, driver safety belt retractor pretensioner, and passenger safety belt retractor pretensioner. This reduces the risk of deployment of air bag modules and safety belt pretensioners while diagnostics are being carried out.

Restraint system diagnostic tools are required to carry out diagnosis and testing of the supplemental restraint system (SRS). It is not acceptable to short-circuit the air bag module connections with a jumper wire. If a jumper wire is used to short-circuit the air bag module connections, a lamp fault code (LFC) will be displayed.

Deactivation and Reactivation Procedures

There are two deactivation and reactivation procedures.

- One procedure requires removal of the front seats. This procedure will be used when diagnosing or repairing a seat side air bag concern. This procedure will also be used when diagnosing or repairing any in-seat or seat mounted component of a seat equipped with a seat side air bag.
- The other procedure does not require front seat removal during the diagnostic and repair process. This procedure will be used when diagnosing or repairing a concern that is not related to a seat equipped with a seat side air bag.

Deactivation Procedure Seats Removed

⚠ WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.

The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury.

NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road.**

NOTE: After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   The side air bag sensors are located at or near the base of the B-pillar.

   To deplete the backup power supply energy, disconnect the battery ground cable and wait at

least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .

2. Wait at least one minute for the backup power supply in the restraints control module (RCM) to deplete its stored energy.

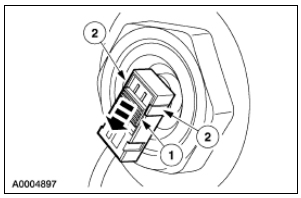
3. **⚠ WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.**

   ⚠ WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

   Remove the driver air bag module from the vehicle. For additional information, refer to Driver Air Bag Module in this section.

4. Attach a restraint system diagnostic tool 418-F395 to the clockspring side of the driver air bag module electrical connector.

5. Remove the glove compartment. For additional information, refer to Section 501-12 .



6. Disconnect the passenger air bag electrical connector.
   1. Reaching over the cross-car beam, slide the passenger air bag module electrical connector lock downward.
   2. Squeeze the electrical connector locking tabs and pull the electrical connector from the passenger air bag module.

7. Attach a restraint system diagnostic tool 418-F395 to the harness side of the passenger air bag module electrical connector.

8. Remove the affected front seat(s). For additional information, refer to Section 501-10 .

9. Disconnect (if necessary) and attach a restraint system diagnostic tool 418-133 to the passenger side air bag module electrical connector.

10. Access the passenger safety belt retractor pretensioner in the passenger side B-pillar.

11. Disconnect the passenger side safety belt retractor pretensioner electrical connector.

12. Attach a restraint system diagnostic tool 418-F088 to the passenger safety belt retractor pretensioner electrical connector.

13. Disconnect (if necessary) and attach a restraint system diagnostic tool 418-133 to the driver side air bag electrical connector.

14. Access the driver safety belt retractor pretensioner in the driver side B-pillar.

15. Disconnect the driver safety belt retractor pretensioner electrical connector.

16. Attach a restraint system diagnostic tool 418-F088 to the driver safety belt retractor pretensioner electrical connector.

17. Reconnect the battery ground cable. For additional information, refer to Section 414-01 .

Reactivation Procedure Seats Removed

⚠ WARNING: The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury.

⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings and notes at the beginning of the deactivation procedure.

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Wait at least one minute for the backup power supply in the restraints control module (RCM) to deplete its stored energy.

3. **⚠ WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   Remove the restraint system diagnostic tool from the driver side air bag module electrical connector.

4. **⚠ WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   Remove the restraint system diagnostic tool from the driver seat belt retractor pretensioner electrical connector.

5. Connect the driver seat belt retractor pretensioner electrical connector.

6. Install the driver side B-pillar trim panels.

7. **⚠ WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   Remove the restraint system diagnostic tool from the passenger side air bag electrical connector.

8. **⚠ WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   Remove the restraint system diagnostic tool from the passenger seat belt buckle pretensioner electrical connector.

9. Connect the passenger seat belt retractor pretensioner electrical connector.

10. Install the passenger side B-pillar trim panels.

11. Install the affected front seat(s). For additional information, refer to Section 501-10 .

12. Connect the driver and passenger side air bag module electrical connectors.

13. **⚠ WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    Remove the restraint system diagnostic tool from the passenger air bag module electrical connector.

14. Reconnect the passenger air bag module electrical connector electrical connector.

15. Install the glove compartment. For additional information, refer to Section 501-12 .

16. **⚠ WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    Remove the restraint system diagnostic tool from the driver air bag module electrical connector.

17. Install the driver air bag module from the vehicle. For additional information, refer to Driver Air Bag Module in this section.

18. Reconnect the battery ground cable. For additional information, refer to Section 414-01 .

19. Prove out the system.

Deactivation Procedure Seats Not Removed

⚠ WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. Refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.

The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury.

NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road.**

NOTE: After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag**

supplemental restraint system (SRS) components and before servicing, replacing adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .

2. Wait at least one minute for the backup power supply in the restraints control module (RCM) to deplete its stored energy.

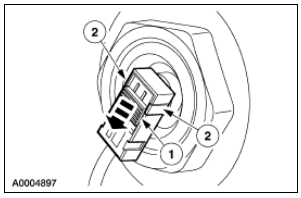
3. ⚠ **WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.**

   ⚠ **WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.**

   Remove the driver air bag module from the vehicle. For additional information, refer to Driver Air Bag Module in this section.

4. Attach a restraint system diagnostic tool 418-F395 to the clockspring side of the driver air bag module electrical connector.

5. Remove the glove compartment. For additional information, refer to Section 501-12 .



6. Disconnect the passenger air bag electrical connector.
   1. Reaching over the cross-car beam, slide the passenger air bag module electrical connector lock downward.
   2. Squeeze the electrical connector locking tabs and pull the electrical connector from the passenger air bag module.

7. Attach a restraint system diagnostic tool 418-F395 to the harness side of the passenger air bag module electrical connector.

8. Reconnect the battery ground cable. For additional information, refer to Section 414-01 .

9. Move and tilt the front seats to their highest and most forward position.

10. ⚠ **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

    The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .

11. Disconnect the passenger side air bag module electrical connector beneath the passenger seat.
12. Attach a restraint system diagnostic tool 418-133 to the passenger side air bag floor electrical connector.
13. Access the passenger safety belt retractor pretensioner in the passenger side B-pillar.
14. Disconnect the passenger side safety belt retractor pretensioner electrical connector.
15. Attach a restraint system diagnostic tool 418-F088 to the passenger safety belt retractor pretensioner electrical connector.
16. Disconnect the driver side air bag module electrical connector beneath the driver seat.
17. Attach a restraint system diagnostic tool 418-133 to the driver side air bag module electrical connector.
18. Access the driver safety belt retractor pretensioner in the driver side B-pillar.
19. Disconnect the driver safety belt retractor pretensioner electrical connector.
20. Attach a restraint system diagnostic tool 418-F088 to the driver safety belt retractor pretensioner electrical connector.
21. Reconnect the battery ground cable. For additional information, refer to Section 414-01 .

Reactivation Procedure Seats Not Removed

⚠ WARNING: The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury.

⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings and notes at the beginning of the deactivation procedure.

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Wait at least one minute for the backup power supply in the restraints control module (RCM) to deplete its stored energy.
3. **⚠ WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   Remove the restraint system diagnostic tool from the driver side air bag module electrical connector.
4. Connect the driver side air bag module electrical connector.

5. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   Remove the restraint system diagnostic tool from the driver seat belt retractor pretensioner electrical connector.

6. Connect the driver seat belt retractor pretensioner electrical connector.

7. Install the driver side B-pillar trim panels.

8. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

   Remove the restraint system diagnostic tool from the passenger side air bag module electrical connector.

9. Connect the passenger side air bag module electrical connector.

10. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    Remove the restraint system diagnostic tool from the passenger seat belt buckle pretensioner electrical connector.

11. Connect the passenger seat belt retractor pretensioner electrical connector.

12. Reconnect the battery ground cable. For additional information, refer to Section 414-01 .

13. Move and tilt the front seats rearward.

14. ⚠ **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

    The side air bag sensors are located at or near the base of the B-pillar.

    To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

    Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .

15. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    Remove the restraint system diagnostic tool from the passenger air bag module electrical connector.

16. Reconnect the passenger air bag module electrical connector electrical connector.

17. Install the glove compartment. For additional information, refer to Section 501-12 .

18. **⚠ WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    Remove the restraint system diagnostic tool from the driver air bag module electrical connector.

19. Install the driver air bag module from the vehicle. For additional information, refer to Driver Air Bag Module in this section.

20. Reconnect the battery ground cable. For additional information, refer to Section 414-01 .

21. Prove out the system.

Prove Out Procedure

Turn the ignition switch from the OFF to the RUN position and visually monitor the air bag indicator with the air bag modules or restraint system diagnostic tools installed. The air bag indicator will light continuously for approximately six seconds and then turn off. If an air bag supplemental restraint system (SRS) fault is present, the air bag indicator will either:

- fail to light.
- remain lit continuously.
- flash.

The flashing might not occur until approximately 30 seconds after the ignition switch has been turned from the OFF to the RUN position. This is the time required for the restraints control module (RCM) to complete the testing of the SRS. If the air bag indicator is inoperative and an SRS fault exists, a chime will sound in a pattern of five sets of five beeps. If this occurs, the air bag indicator will need to be repaired before diagnosis can continue.

Glossary

Restraint System Diagnostic Tools

Restraint system diagnostic tools are used to simulate air bag module connections to the system.

Disconnect the Component

Disconnect the component means disconnect the component vehicle harness connector. It does not mean remove the component. Do not reconnect a disconnected component unless instructed to do so.

Deactivate the System

Deactivate the system means to carry out the deactivation procedure. Refer to Deactivation Procedure in this section.

Prove Out the System

Prove out the system means to turn the ignition switch from the OFF to the RUN position and visually monitor the air bag indicator with the air bag modules installed. Refer to Prove Out Procedure in this section.

Reactivate the System

Reactivate the system means to carry out the reactivation procedure. Refer to Reactivation Procedure in this section.

Reconnect the System

Reconnect the system means to reconnect all system components. Refer to Air Bag Reconnect Checklist in this section.

Install a New Component

Install a new component means to remove the existing component and install a new authorized part obtained from Ford Customer Service Division.

Verify the System

Verify the system means to prove out the system with restraint system diagnostic tools for the air bag modules in place of the components.

Air Bag Reconnect Checklist

The checklist below should be completed following diagnosis or repair of any air bag system concern:

1. All restraint system diagnostic tools removed?
2. All in-seat electrical connectors connected?
3. All air bag modules connected?
4. Restraints control module (RCM) connected?
5. All safety belt pretensioners connectors connected?
6. All sensors (side impact) connected?
7. Battery connected?

Diagnostic Instructions Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

The symptom chart can be used to help locate the air bag supplemental restraint system (SRS) concerns if no diagnostic trouble codes (DTCs) are retrieved and the listed symptoms are observed. Whether or not the listed symptoms are observed, always carry out the following:

1. Retrieve all DTCs stored in the restraints control module (RCM) memory. For additional information, refer to Retrieve/Clear Continuous DTCs in this section.

2. Run the On-Demand Self Test to determine what DTCs are currently being sensed by the RCM. For additional information, refer to On-Demand Self Test in this section.

3. If the stored DTCs are different than the current DTCs, always repair the current DTCs first.

4. If memory displays different continuous DTCs than the On-Demand Self Test, perform in the following order:

- On-Demand Self Test.
- Memory (Retrieve/Clear Continuous DTCs).

A DTC can indicate several concerns. The DTCs are to assist in system diagnosis and are not to be considered definitive. Always refer to the pinpoint test corresponding to the DTC to determine where the concern lies and to repair the concern correctly.

The SRS diagnostics can be divided into three sections:

- diagnostic test modes.
- PID/data monitor and record.
- active command modes.

Diagnostic Test Modes

Two menu options are available under the diagnostic test modes:

- Retrieve/Clear Continuous DTCs.
- On-Demand Self Test.

Retrieve/Clear Continuous DTCs

During vehicle operation the restraints control module (RCM) will detect and store both intermittent and hard fault DTCs in nonvolatile memory. The DTC strategy employed by the RCM incorporates a time-out scheme for determining when a concern exists in the system. This requires a concern to exist for up to one minute in the system before the RCM will detect it. For the RCM to determine that a concern no longer exists, the concern must be absent for up to one minute. The actual detection time-outs vary with each DTC. The DTCs can be retrieved with the scan tool. Any DTCs stored in the RCM will be displayed on the scan tool along with a brief description of the DTC. If no DTCs are present, the scan tool will display a SYSTEM PASSED message. The scan tool can also be used to clear DTCs from the RCM memory, as long as the concern no longer exists. Once 254 key cycles have been recorded since the concern was last detected, the DTC will automatically be removed from memory.

To retrieve or clear DTCs, connect the scan tool to the data link connector (DLC). Follow the instructions for the scan tool being used. All continuous DTCs will be displayed on the screen. Before proceeding with the clearing operation, make note of the DTCs displayed, because once cleared, they cannot be retrieved. Hard DTCs will be redisplayed after clearing DTCs since they cannot be cleared from the RCM.

On-Demand Self Test

The On-Demand Self Test option is used to verify that no electrical concerns exist with the air bag supplemental restraint system (SRS). Upon entering the self test, the restraint control module (RCM) will make an electrical check of each electrical component in the system. If a concern is detected, a DTC is displayed on the scan tool with a brief description of the DTC. Concerns detected during the self test are not stored in memory, unless the same concern was also detected during normal vehicle operation. The self test should always be run after any repair to verify that the repair was successful.

To run the On-Demand Self Test, connect the scan tool to the data link connector (DLC). Follow the instructions for the scan tool being used. The RCM will run the On-Demand Self Test and display on-demand DTCs (reflecting hard system concerns) on the screen.

PID/Data Monitor and Record

The PID/Data Monitor and Record option allows the scan tool operator to read the state of several parameter IDs (PIDs) to aid in diagnosing the system. PIDs are real time measurements of parameters such as voltages, resistances, etc., calculated by the restraints control module (RCM) and sent to the scan tool for display. Many of the PIDs supported by the RCM are calculated periodically and therefore are not true real time readings.

To retrieve PIDs, connect the scan tool to the data link connector (DLC). Follow the instructions for the scan tool being used. PIDs are updated continuously on the display.

Active Commands

This command allows the technician to verify operation of the air bag indicator and chime. When the air bag output command is executed, the indicator and the chime are activated simultaneously for approximately four seconds. Both devices are deactivated automatically.

Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table

DTC [a]			Description	Action To Take

	LFC [b]	LFC Priority		
		1	RCM Disconnected, Inoperative, or Lost/Low Ignition Feed	Go To Pinpoint Test A .
B1342	24	2	RCM is Faulted	INSTALL a new RCM.
B1231	19	3	RCM Crash Data Memory Full	INSTALL a new RCM and impact sensors.
B1921	21	4	RCM Bracket Ground Resistance High	Go To Pinpoint Test B .
C1414	29	5	Incorrect Vehicle Identification Code	Go To Pinpoint Test C .
B1887	15	6	Driver Air Bag Circuit Shorted to Ground	Go To Pinpoint Test D .
B1888	16	7	Passenger Air Bag Circuit Shorted to Ground	Go To Pinpoint Test E .
B1916	15	6	Driver Air Bag Circuit Shorted to Battery or Ignition	Go To Pinpoint Test F .
B1925	16	7	Passenger Air Bag Circuit Shorted to Battery or Ignition	Go To Pinpoint Test G .
B1932	32	8	Driver Air Bag Circuit Resistance High	Go To Pinpoint Test H .
B1933	33	9	Passenger Air Bag Circuit Resistance High	Go To Pinpoint Test I
B1934	34	10	Driver Air Bag Circuit Resistance Low	Go To Pinpoint Test J .
B1935	35	11	Passenger Air Bag Circuit Resistance Low	Go To Pinpoint Test K .
B2444	48	16	Driver Side Crash Sensor is Faulted	Go To Pinpoint Test L .
B2440	43	19	Passenger Side Crash Sensor Mounting Fault	Go To Pinpoint Test M .
B2441	42	18	Driver Side Crash Sensor Mounting Fault	Go To Pinpoint Test N .
B2445	49	17	Passenger Side Crash Sensor is Faulted	Go To Pinpoint Test O .
U2017	44	20	Driver Side Crash Sensor Communication Fault	Go To Pinpoint Test P .
U2018	45	21	Passenger Side Crash Sensor Communication Fault	Go To Pinpoint Test Q .
B1993	36	22	Driver Side Air Bag Circuit Shorted to Ground	Go To Pinpoint Test R .
B1997	37	23	Passenger Side Air Bag Circuit Shorted to Ground	Go To Pinpoint Test S .
B1992	36	22	Driver Side Air Bag Circuit Shorted to Battery or Ignition	Go To Pinpoint Test T .
B1996	37	23	Passenger Side Air Bag Circuit Shorted to Battery or Ignition	Go To Pinpoint Test U .
B1994	36	22	Driver Side Air Bag Circuit High Resistance	Go To Pinpoint Test V .
B1998	37	23	Passenger Side Air Bag Circuit Resistance High	Go To Pinpoint Test W .
B1995	36	22	Driver Side Air Bag Circuit Resistance Low	Go To Pinpoint Test X .
B1999	37	23	Passenger Side Air Bag Circuit Resistance Low	Go To Pinpoint Test Y .
B1877	46	24	Driver Pretensioner Circuit Resistance High	Go To Pinpoint Test Z .
B1885	46	24	Driver Pretensioner Circuit Resistance Low	Go To Pinpoint Test Z .
B1881	47	25	Passenger Pretensioner Circuit Resistance High	Go To Pinpoint Test AA .
B1886	47	25	Passenger Pretensioner Circuit Resistance Low	Go To Pinpoint Test AA .
B1878	17	26	Driver Pretensioner Circuit Shorted to Battery or Ignition	Go To Pinpoint Test AB .
B1879	17	26	Driver Pretensioner Circuit Shorted to Ground	Go To Pinpoint Test AC .
B1882	18	27	Passenger Pretensioner Circuit Shorted to Battery or Ignition	Go To Pinpoint Test AD .

B1883	18	27	Passenger Pretensioner Circuit Shorted to Ground	Go To Pinpoint Test AE .
B1892			Air Bag Tone Warning Indicator Circuit Shorted to Ground or Open	Go To Pinpoint Test AF .
B1891			Air Bag Tone Warning Indicator Circuit Shorted to Battery or Ignition	Go To Pinpoint Test AG .
B1869	Tone [c]		Air Bag Indicator Inoperative	Go To Pinpoint Test AH .
B1870	Tone [c]		Air Bag Indicator Shorted to Battery	Go To Pinpoint Test AI .
			No Communication with the Restraints Control Module (RCM)	Go To Pinpoint Test AJ .
	5Hz		RCM in Plant Mode	Go To Pinpoint Test AK .

[a] DTC: Diagnostic trouble code, retrieved using scan tool.
[b] LFC: Lamp fault code, flashed on air bag indicator.
[c] Tone will sound only if additional DTCs are present.

Inspection and Verification

1. Verify the customer concern by checking the air bag indicator in the instrument cluster. For additional information, refer to Prove Out Procedure in this section.

2. Visually inspect for obvious signs of mechanical and electrical damage using the following chart.

Visual Inspection Chart

Mechanical	Electrical
• Damaged restraints control module (RCM) bracket • Loose component mounting	• Open fuse(s) • Damaged wiring harness • Loose or corroded connectors • Circuitry open/shorted • Damaged shorting bars

3. If the concern is not visually evident, use the scan tool to retrieve diagnostic trouble codes (DTCs) and carry out the on-demand self test.

4. If the on-demand self test is passed and no DTCs are retrieved, GO to Symptom Chart .

5. If DTCs are retrieved, refer to the Restraints Control Module (RCM) Diagnostic Trouble Code (DTC) Priority Table.

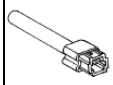
Symptom Chart

Symptom Chart

Pinpoint Tests Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

Refer to Wiring Diagrams Cell 46 for schematic and connector information.

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST1590-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2306-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)
 ST1137-A	FLUKE 73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Restraint System Diagnostic Tool Warning

⚠ WARNING: Restraint system diagnostic tools are for service only. Tools must be removed prior to operating the vehicle over the road. Failure to remove diagnostic tools could result in injury and possible violation of vehicle safety standards.

Pinpoint Test A: Air Bag Warning Indicator Is Illuminated Continuously RCM Disconnected, Inoperative or Lost/Low Ignition Feed

Normal Operation

NOTE: Be sure to cycle the ignition switch and look for a 6 second indicator prove-out without LFCs.

During normal operation the air bag indicator will illuminate continuously for 6 seconds after the ignition switch is placed in the RUN position. The air bag indicator will also illuminate after five cycles of a lamp fault code (LFC) if a fault exists. The restraints control module (RCM) will communicate diagnostic trouble codes (DTCs) to the scan tool through the data link connector (DLC). If the scan tool displays NO COMMUNICATION when retrieving continuous DTCs, use Pinpoint Test AL to troubleshoot the system.

Possible Causes

An air bag indicator that is illuminated continuously can be caused by:

- a damaged shorting bar or other electrical connector component.
- the ignition circuit damaged.

- the RCM disconnected from the vehicle harness.
- a loss of RCM ground circuit.
- the RCM is faulted.
- air bag indicator circuit shorted to ground.

PINPOINT TEST A: AIR BAG WARNING INDICATOR IS ILLUMINATED CONTINUOUSLY RCM DISCONNECTED, INOPERATIVE OR LOST/LOW IGNITION FEED

Pinpoint Test B: LFC 21/DTC B1921 RCM Bracket Ground Resistance High

Normal Operation

⚠ WARNING: The tightening torque of the restraints control module (RCM) retaining bolts is critical for proper air bag supplemental restraint system (SRS) operation. Refer to Restraints Control Module (RCM) in this section for correct torque values.

The restraints control module (RCM) monitors the resistance between the ground connections at its housing and the reference ground at pin 21. If the RCM detects a resistance greater than 100 ohms, it will store a diagnostic trouble code (DTC) B1921 in memory and flash a lamp fault code (LFC) 21 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

High resistance between the RCM housing ground and pin ground can be caused by:

- incorrect seating of the RCM retaining bolts.
- incorrect tightening torque of the RCM retaining bolts.
- high resistance on RCM logic ground circuit 31-JA10A (BK/RD).

PINPOINT TEST B: LFC 21/DTC B1921 RCM BRACKET GROUND RESISTANCE HIGH

Pinpoint Test C: LFC 29/DTC C1414 Incorrect Vehicle Identification Code

Normal Operation

The restraints control module (RCM) monitors the electrical condition at C310a pins 10, 13 and 14 to determine if it is installed on the correct vehicle. If the RCM detects an unexpected condition on any of these pins, it will store a diagnostic trouble code (DTC) C1414 in memory and flash a lamp fault code (LFC) 29 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

An incorrect vehicle ID code can be caused by:

- incorrect RCM.
- RCM incorrectly programmed.
- a wiring concern at RCM C310a pins 10, 13 and 14.

PINPOINT TEST C: LFC 29/DTC C1414 INCORRECT VEHICLE IDENTIFICATION CODE

Pinpoint Test D: LFC 15/DTC B1887 Driver Air Bag Circuit Shorted to Ground

Normal Operation

The restraints control module (RCM) checks for driver air bag circuit shorts to ground by monitoring the voltage of circuits 30S-JA8 (RD/OG) and 31S-JA8 (BK/OG) at pins 3 and 4. If the RCM detects a short to ground on either of these pins, it will store a diagnostic trouble code (DTC) B1887 in memory and flash a lamp fault code (LFC) 15 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

A driver air bag circuit short to ground can be caused by:

- a short to ground on circuit 30S-JA8 (RD/OG).
- a short to ground on circuit 31S-JA8 (BK/OG).
- a short to ground on the clockspring (14A664).
- a short to ground on the driver air bag module.

PINPOINT TEST D: LFC 15/DTC B1887 DRIVER AIR BAG CIRCUIT SHORTED TO GROUND

Pinpoint Test E: LFC 16/DTC B1888 Passenger Air Bag Circuit Shorted to Ground

Normal Operation

The restraints control module (RCM) checks for passenger air bag circuit shorts to ground by monitoring the voltage of circuits 30S-JA11 (RD/WH) and 31S-JA11 (BK/WH) at pins 6 and 7. If the RCM detects a short to ground on either of these pins, it will store a diagnostic trouble code (DTC) B1888 in memory and flash a lamp fault code (LFC) 16 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

A passenger air bag circuit short to ground can be caused by:

- a short to ground on circuit 30S-JA11 (RD/WH).
- a short to ground on circuit 31S-JA11 (BK/WH).
- a short to ground on the passenger air bag module.

PINPOINT TEST E: LFC 16/DTC B1888 PASSENGER AIR BAG CIRCUIT SHORTED TO GROUND

Pinpoint Test F: LFC 15/DTC B1916 Driver Air Bag Circuit Shorted to Battery or Ignition

Normal Operation

The restraints control module (RCM) checks for driver air bag circuit shorts to battery or ignition by monitoring the voltage of circuit 30S-JA8 (RD/OG) and 31S-JA8 (BK/OG) at pins 3 and 4. If the RCM detects a short to battery or ignition on either of these pins, it will store a diagnostic trouble code (DTC) B1916 in memory and flash a lamp fault code (LFC) 15 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

A driver air bag circuit short to battery or ignition can be caused by:

- a short to battery or ignition on circuit 30S-JA8 (RD/OG).
- a short to battery or ignition on circuit 31S-JA8 (BK/OG).
- a short to battery or ignition on the clockspring.
- a short to battery or ignition on the driver air bag module.

PINPOINT TEST F: LFC 15/DTC B1916 DRIVER AIR BAG CIRCUIT SHORTED TO BATTERY OR IGNITION

Pinpoint Test G: LFC 16/DTC B1925 Passenger Air Bag Circuit Shorted to Battery or Ignition

Normal Operation

The restraints control module (RCM) checks for passenger air bag circuit shorts to battery or ignition by monitoring the voltage of circuits 30S-JA11 (RD/WH) and 31S-JA11 (BK/WH) at pins 6 and 7. If the RCM detects a short to battery or ignition on either of these pins, it will store a diagnostic trouble code (DTC) B1925 in memory and flash a lamp fault code (LFC) 16 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

A passenger air bag circuit short to battery or ignition can be caused by:

- a short to battery or ignition on circuit 30S-JA11 (RD/WH).
- a short to battery or ignition on circuit 31S-JA11 (BK/WH).
- a short to battery or ignition on the passenger air bag module.
- an RCM internal concern.

PINPOINT TEST G: LFC 16/DTC B1925 PASSENGER AIR BAG CIRCUIT SHORTED TO BATTERY OR IGNITION

Pinpoint Test H: LFC 32/DTC B1932 Driver Air Bag Circuit Resistance High

Normal Operation

The restraints control module (RCM) monitors the resistance of the driver air bag ignitor by measuring the resistance between pins 3 and 4. If the RCM detects high resistance between these pins, it will store a diagnostic trouble code (DTC) B1932 in memory and flash a lamp fault code (LFC) 32 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

Driver air bag high resistance can be caused by:

- a poor connection or corrosion in the driver air bag module circuits or the clockspring.
- high resistance in the clockspring.
- high resistance in the wiring harness.
- high resistance in the driver air bag module.
- RCM is faulted.

PINPOINT TEST H: LFC 32/DTC B1932 DRIVER AIR BAG CIRCUIT RESISTANCE HIGH

Pinpoint Test I: LFC 33/DTC B1933 Passenger Air Bag Circuit Resistance High

Normal Operation

The restraints control module (RCM) monitors the resistance of the passenger air bag ignitor by measuring the resistance between pins 6 and 7. If the RCM detects high resistance between these pins, it will store a diagnostic trouble code (DTC) B1933 in memory and flash a lamp fault code (LFC) 33 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

A passenger air bag high resistance can be caused by:

- a poor connection or corrosion in the passenger air bag module circuits.
- high resistance in the wiring harness.
- high resistance in the passenger air bag module.
- RCM is faulted.

PINPOINT TEST I: LFC 33/DTC B1933 PASSENGER AIR BAG CIRCUIT RESISTANCE HIGH

Pinpoint Test J: LFC 34/DTC B1934 Driver Air Bag Circuit Resistance Low

Normal Operation

The restraints control module (RCM) monitors the resistance of the driver air bag ignitor by measuring the resistance between pins 3 and 4. If the RCM detects low resistance between these pins, it will store a diagnostic trouble code (DTC) B1934 in memory and flash a lamp fault code (LFC) 34 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

Driver air bag low resistance can be caused by:

- a short in the clockspring.
- a short in the wiring harness.
- a low resistance in the driver air bag module.
- worn or damaged electrical connector shorting bar.
- worn or damaged electrical connector camming beam.
- RCM is faulted.

PINPOINT TEST J: LFC 34/DTC B1934 DRIVER AIR BAG CIRCUIT RESISTANCE LOW

Pinpoint Test K: LFC 35/DTC B1935 Passenger Air Bag Circuit Resistance Low

Normal Operation

The restraints control module (RCM) monitors the resistance of the passenger air bag ignitor by measuring the resistance between pins 6 and 7. If the RCM detects low resistance between these pins, it will store a diagnostic trouble code (DTC) B1935 in memory and flash a lamp fault code (LFC) 35 (or higher priority code if one exists) on the air bag indicator.

Possible Causes

Passenger air bag low resistance can be caused by:

- a short in the wiring harness.
- a low resistance in the passenger air bag module.

- an RCM internal concern.
- a worn or damaged electrical connector shorting bar.
- a worn or damaged electrical connector camming beam.

PINPOINT TEST K: LFC 35/DTC B1935 PASSENGER AIR BAG CIRCUIT RESISTANCE LOW

Pinpoint Test L: LTC 48/DTC B2444 Driver Seat Side Impact Sensor Is Faulted

Normal Operation

The driver seat side impact sensor monitors the severity of a crash event. If the crash is severe enough, the sensor will signal the restraints control module (RCM) to deploy the driver seat side air bag.

The RCM monitors the two-wire current loop to the driver seat side impact sensor for a signal that is out of the expected range. If the RCM detects an out-of-range signal from the driver seat side impact sensor, indicating a fault, it will store diagnostic trouble code (DTC) B2444 and flash a lamp fault code (LFC) 48 (or a higher priority code if one exists) on the air bag indicator.

Possible Causes

A driver seat side impact sensor fault can be caused by:

- Faulted driver seat side impact sensor.

PINPOINT TEST L: LFC 48/DTC B2444 DRIVER SEAT SIDE IMPACT SENSOR IS FAULTED

Pinpoint Test M: LFC 43/DTC B2440 Passenger Seat Side Impact Sensor Mounting Fault

Normal Operation

The passenger seat side impact sensor monitors the severity of a crash event. If the crash is severe enough, the sensor will signal the restraints control module (RCM) to deploy the passenger seat side air bag.

The RCM monitors the two-wire current loop to the passenger seat side impact sensor for a signal that is out of the expected range. If the RCM detects an out-of-range signal from the passenger seat side impact sensor, indicating a sensor mounting fault, it will store diagnostic trouble code (DTC) B2440 and flash a lamp fault code (LFC) 43 (or a higher priority code if one exists) on the air bag indicator.

Possible Causes

A passenger seat side impact sensor mounting fault can be caused by:

- a passenger seat side impact sensor internal fault.
- a passenger seat side impact sensor mounting fault.
- RCM is faulted.

PINPOINT TEST M: LFC 43/DTC B2440 PASSENGER SEAT SIDE IMPACT SENSOR MOUNTING FAULT

Pinpoint Test N: LFC 42/DTC B2441 Driver Seat Side Impact Sensor Mounting Fault

Normal Operation

The driver seat side impact sensor monitors the severity of a crash event. If the crash is severe enough, the sensor will signal the restraints control module (RCM) to deploy the driver seat side air bag.

The RCM monitors the two-wire current loop to the driver seat side impact sensor for a signal that is out of the expected range. If the RCM detects an out-of-range signal from the driver seat side impact sensor, indicating a sensor mounting fault, it will store diagnostic trouble code (DTC) B2441 and flash a lamp fault code (LFC) 42 (or a higher priority code if one exists) on the air bag indicator.

Possible Causes

A driver seat side impact sensor mounting fault can be caused by:

- a driver seat side impact sensor internal fault.
- a driver seat side impact sensor mounting fault.
- RCM is faulted.

PINPOINT TEST N: LFC 42/DTC B2441 DRIVER SEAT SIDE IMPACT SENSOR MOUNTING FAULT

Pinpoint Test O: LFC 49/DTC B2445 Passenger Seat Side Impact Sensor Is Faulted

Normal Operation

The passenger seat side impact sensor monitors the severity of a crash event. If the crash is severe enough, the sensor will signal the restraints control module (RCM) to deploy the passenger seat side air bag.

The RCM monitors the two-wire current loop to the passenger seat side impact sensor for a signal that is out of the expected range. If the RCM detects an out-of-range signal from the passenger seat side impact sensor, indicating a fault, it will store diagnostic trouble code (DTC) B2445 and flash a lamp fault code (LFC) 49 (or a higher priority code if one exists) on the air bag indicator.

Possible Causes

A passenger seat side impact sensor fault can be caused by:

- damaged passenger seat side impact sensor.

PINPOINT TEST O: LFC 49/DTC B2445 PASSENGER SEAT SIDE IMPACT SENSOR IS FAULTED

Pinpoint Test P: LFC 44/DTC U2017 Driver Side Impact Sensor Communication Fault

Normal Operation

The driver seat side impact sensor monitors the severity of a crash event. If the crash is severe enough, the sensor will signal the restraints control module (RCM) to deploy the driver seat side air bag.

The RCM monitors the two-wire current loop to the driver seat side impact sensor for a signal that is out of the expected range. If the RCM detects an out-of-range signal from the driver seat side impact sensor, indicating a sensor communication fault, it will store diagnostic trouble code (DTC) U2017 and flash a lamp fault code (LFC) 44 (or a higher priority code if one exists) on the air bag indicator.

Possible Causes

A driver seat side impact sensor communication fault can be caused by:

- damaged wiring on circuit 7-JA39 (YE).
- damaged wiring on circuit 9-JA39 (BN).
- damaged driver seat side impact sensor.

PINPOINT TEST P: LFC 44/DTC U2017 DRIVER SEAT SIDE IMPACT SENSOR COMMUNICATION FAULT

Pinpoint Test Q: LFC 45/DTC U2018 Passenger Seat Side Impact Sensor Communication Fault

Normal Operation

The passenger seat side impact sensor monitors the severity of a crash event. If the crash is severe enough, the sensor will signal the restraints control module (RCM) to deploy the passenger seat side air bag.

The RCM monitors the two-wire current loop to the passenger seat side impact sensor for a signal that is out of the expected range. If the RCM detects an out-of-range signal from the passenger seat side impact sensor, indicating a sensor communication fault, it will store diagnostic trouble code (DTC) U2018 and flash a lamp fault code (LFC) 45 (or a higher priority code if one exists) on the air bag indicator.

Possible Causes

A passenger seat side impact sensor communication fault can be caused by:

- damaged wiring on circuit 7-JA40 (YE/VT).
- damaged wiring on circuit 9-JA40 (BN/WH).
- damaged passenger seat side impact sensor.

PINPOINT TEST Q: LFC LFC 45/DTC U2018 PASSENGER SIDE IMPACT SENSOR COMMUNICATION FAULT

Pinpoint Test R: LFC 36/DTC B1993 Driver Seat Side Air Bag Circuit Shorted to Ground

Normal Operation

The restraints control module (RCM) monitors the resistance to ground at RCM C310b pins 2 and 3. If the resistance is less than 10,000 ohms at either pin, the RCM will interpret that as a ground short, store diagnostic trouble code (DTC) B1993 and flash lamp fault code (LFC) 36.

Possible Causes

A driver seat side air bag circuit short to ground can be caused by:

- grounded wiring on circuit 30S-JA37 (RD/GN).
- damaged wiring on circuit 31S-JA37 (BK/GN).
- ground short in the driver seat side air bag module.
- RCM is faulted.

PINPOINT TEST R: LFC 36/DTC B1993 DRIVER SIDE AIR BAG CIRCUIT SHORTED TO GROUND

Pinpoint Test S: LFC 37/DTC B1997 Passenger Seat Side Air Bag Circuit Shorted to Ground

Normal Operation

The restraints control module (RCM) monitors the resistance to ground at RCM C310b pins 5 and 6. If the resistance is less than 10,000 ohms at either pin, the RCM will interpret that as a ground short, store diagnostic trouble code (DTC) B1997 and flash lamp fault code (LFC) 37.

Possible Causes

A passenger seat side air bag circuit short to ground can be caused by:

- grounded wiring on circuit 30S-JA38 (RD/BK).
- damaged wiring on circuit 31S-JA38 (BK/RD).
- ground short in the passenger seat side air bag module.
- RCM is faulted.

PINPOINT TEST S: LFC 37/DTC B1997 PASSENGER SEAT SIDE AIR BAG CIRCUIT SHORTED TO GROUND

Pinpoint Test T: LFC 36/DTC B1992 Driver Seat Side Air Bag Circuit Shorted to Battery or Ignition

Normal Operation

The restraints control module (RCM) monitors the driver seat side air bag circuits at RCM C310b pins 2 and 3 for a short to battery or ignition. If battery or ignition voltage is detected, the RCM will store diagnostic trouble code (DTC) B1992 and flash lamp fault code (LFC) 36.

Possible Causes

A driver seat side air bag circuit short to battery or ignition can be caused by:

- battery or ignition voltage on circuit 30S-JA38 (RD/BK).
- battery or ignition voltage on circuit 31S-JA38 (BK/RD).
- battery or ignition voltage short in the driver seat side air bag module.
- RCM is faulted.

PINPOINT TEST T: LFC 36/DTC B1992 DRIVER SEAT SIDE AIR BAG CIRCUIT SHORTED TO BATTERY OR IGNITION

Pinpoint Test U: LFC 37/DTC B1996 Passenger Seat Side Air Bag Circuit Shorted to Battery or Ignition

Normal Operation

The restraints control module (RCM) monitors the passenger seat side air bag circuits at RCM C310b pins 5 and 6 for a short to battery or ignition. If battery or ignition voltage is detected, the RCM will store diagnostic trouble code (DTC) B1996 and flash lamp fault code (LFC) 37.

Possible Causes:

A passenger seat side air bag circuit short to battery or ignition can be caused by:

- battery or ignition voltage on circuit 30S-JA38 (RD/BK).
- battery or ignition voltage on circuit 31S-JA38 (BK/RD).
- battery or ignition voltage short in the passenger seat side air bag module.
- RCM is faulted.

PINPOINT TEST U: LFC 37/DTC B1996 PASSENGER SEAT SIDE AIR BAG CIRCUIT SHORTED TO BATTERY OR IGNITION

Pinpoint Test V: LFC 36/DTC B1994 Driver Seat Side Air Bag Circuit Resistance High

Normal Operation

The restraints control module (RCM) monitors the resistance of the driver seat side air bag circuit loop and the air bag module igniter at RCM C301b pins 2 and 3. If the resistance is greater than 3.6 ohms, the RCM will store diagnostic trouble code (DTC) B1994 and flash lamp fault code (LFC) 36.

Possible Causes

A high resistance on the driver seat side air bag circuit can be caused by:

- damaged wiring on circuit 30S-JA37 (RD/GN).
- damaged wiring on circuit 31S-JA37 (BK/GN).
- damaged driver seat side air bag module.
- RCM is faulted.

PINPOINT TEST V: LFC 36/DTC B1994 DRIVER SEAT SIDE AIR BAG CIRCUIT RESISTANCE HIGH

Pinpoint Test W LFC 37/DTC B1998 Passenger Seat Side Air Bag Circuit Resistance High

Normal Operation

The restraints control module (RCM) monitors the resistance of the passenger seat side air bag circuit loop and the air bag module igniter at RCM C301b pins 5 and 6. If the resistance is greater than 3.6 ohms, the RCM will store diagnostic trouble code (DTC) B1998 and flash lamp fault code (LFC) 37.

Possible Causes

A high resistance on the passenger seat side air bag circuit can be caused by:

- damaged wiring on circuit 30S-JA38 (RD/BK).
- damaged wiring on circuit 31S-JA38 (BK/RD).
- damaged passenger seat side air bag module.
- RCM is faulted.

PINPOINT TEST W: LFC 37/DTC B1998 PASSENGER SIDE AIR BAG CIRCUIT RESISTANCE HIGH

Pinpoint Test X: LFC 36/DTC B1995 Driver Seat Side Air Bag Circuit Resistance Low

Normal Operation

The restraints control module (RCM) monitors the resistance of the driver seat side air bag circuit loop and the air bag module igniter at RCM C310b pin 2 and 3. If the resistance is less than 0.7 ohms, the RCM will store diagnostic trouble code (DTC) B1995 and flash lamp fault code (LFC) 36.

Possible Causes

A low resistance on the driver seat side air bag circuit can be caused by:

- damaged wiring on circuit 30S-JA37 (RD/GN).
- damaged wiring on circuit 31S-JA37 (BK/GN).
- damaged driver seat side air bag module.
- RCM is faulted.
- damaged electrical connector shorting bar.
- damaged electrical connector camming beam.

PINPOINT TEST X: LFC 36/DTC B1995 DRIVER SEAT SIDE AIR BAG CIRCUIT RESISTANCE LOW

Pinpoint Test Y: LFC 37/DTC B1999 Passenger Seat Side Air Bag Circuit Resistance Low

Normal Operation

The restraints control module (RCM) monitors the resistance of the passenger seat side air bag circuit loop and the air bag module igniter at RCM C310b pins 5 and 6. If the resistance is less than 0.7 ohms, the RCM will store diagnostic trouble code (DTC) B1999 and flash lamp fault code (LFC) 37.

Possible Causes

A low resistance on the passenger seat side air bag circuit can be caused by:

- damaged wiring on circuit 30S-JA38 (RD/BK).
- damaged wiring on circuit 31S-JA38 (BK/RD).
- damaged passenger seat side air bag module.
- RCM is faulted.
- damaged electrical connector shorting bar.
- damaged electrical connector camming beam.

PINPOINT TEST Y: LFC 37/DTC B1999 PASSENGER SIDE AIR BAG CIRCUIT RESISTANCE LOW

Pinpoint Test Z: LFC 46/DTC B1885/B1877 Driver Safety Belt Retractor Pretensioner Circuit Resistance High or Low

Normal Operation

The restraints control module (RCM) monitors the resistance of the circuit to the driver safety belt retractor pretensioner. When the RCM detects a resistance that is out of the expected range (high or low) it will set lamp fault code (LFC) 46 and diagnostic test code (DTC) B1885 or B1877.

Possible Causes

An out of range resistance on the driver safety belt retractor pretensioner circuit can be caused by:

- out of range resistance on circuit 30S-JA33 (RD/BU).
- out of range resistance on circuit 31S-JA33 (BK/BU).
- out of range resistance on the driver safety belt retractor pretensioner.
- RCM is faulted.

PINPOINT TEST Z: LFC 46/DTC B1885/B1877 DRIVER SAFETY BELT RETRACTOR PRETENSIONER CIRCUIT RESISTANCE HIGH OR LOW

Pinpoint Test AA: LFC 47/DTC B1881/B1886 Passenger Safety Belt Retractor Pretensioner Circuit Resistance High or Low

Normal Operation

The restraints control module (RCM) monitors the resistance of the circuit to the passenger safety belt retractor pretensioner. When the RCM detects a resistance that is out of the expected range (high or low) it will set lamp fault code (LFC) 47 and diagnostic test code (DTC) B1881 or B1886.

Possible Causes

An out of range resistance on the passenger safety belt retractor pretensioner circuit can be caused by:

- out of range resistance on circuit 30S-JA34 (RD/BK).
- out of range resistance on circuit 31S-JA34 (BK/RD).
- out of range resistance on the passenger safety belt retractor pretensioner.
- RCM is faulted.

PINPOINT TEST AA: LFC 47/DTC B1881/B1886 PASSENGER SAFETY BELT RETRACTOR PRETENSIONER CIRCUIT RESISTANCE HIGH OR LOW

Pinpoint Test AB: LFC 17/DTC B1878 Driver Safety Belt Retractor Pretensioner Circuit Shorted to Battery or Ignition

Normal Operation

The restraints control module (RCM) monitors the circuit to the driver safety belt retractor pretensioner. When the RCM detects a circuit short to battery or ignition it will set lamp fault code (LFC) 17 and diagnostic test code (DTC) B1878.

Possible Causes

A short to battery or ignition on the driver safety belt retractor pretensioner circuit can be caused by:

- a short to battery or ignition on circuit 30S-JA33 (RD/BU).
- a short to battery or ignition on circuit 31S-JA33 (BK/BU).
- a short to battery or ignition on the driver safety belt retractor pretensioner.
- RCM is faulted.

PINPOINT TEST AB: LFC 17/DTC B1878 DRIVER SAFETY BELT RETRACTOR PRETENSIONER CIRCUIT SHORTED TO BATTERY OR IGNITION

Pinpoint Test AC: LFC 17/DTC B1879 Driver Safety Belt Retractor Pretensioner Circuit Shorted to Ground

Normal Operation

The restraints control module (RCM) monitors the circuit to the driver safety belt retractor pretensioner. When the RCM detects a circuit short to ground it will set lamp fault code (LFC) 17 and diagnostic test code (DTC) B1879.

Possible Causes

A short to ground on the driver safety belt retractor pretensioner circuit can be caused by:

- a short to ground on circuit 30S-JA33 (RD/BU).
- a short to ground on circuit 31S-JA33 (BK/BU).
- a short to ground on the driver safety belt retractor pretensioner.
- RCM is faulted.

PINPOINT TEST AC: LFC 17/DTC B1879 DRIVER PRETENSIONER CIRCUIT SHORTED TO GROUND

Pinpoint Test AD: LFC 18/DTC B1882 Passenger Safety Belt Retractor Pretensioner Circuit Shorted to Battery or Ignition

Normal Operation

The restraints control module (RCM) monitors the circuit to the passenger safety belt retractor pretensioner. When the RCM detects a circuit short to battery or ignition it will set lamp fault code (LFC) 18 and diagnostic test code (DTC) 1882.

Possible Causes

A short to battery or ignition on the passenger safety belt retractor pretensioner circuit can be caused by:

- a short to battery or ignition on circuit 30S-JA34 (RD/BK).
- a short to battery or ignition on circuit 31S-JA34 (BK/RD).
- a short to battery or ignition on the passenger safety belt retractor pretensioner.
- RCM is faulted.

PINPOINT TEST AD: LFC 18/DTC B1882 PASSENGER SAFETY BELT RETRACTOR PRETENSIONER CIRCUIT SHORTED TO BATTERY OR IGNITION

Pinpoint Test AE: LFC 18/DTC B1883 Passenger Safety Belt Retractor Pretensioner Circuit Shorted to Ground

Normal Operation

The restraints control module (RCM) monitors the circuit to the passenger safety belt retractor pretensioner. When the RCM detects a circuit short to ground it will set lamp fault code (LFC) 18 and diagnostic test code (DTC) B1883.

Possible Causes

A short to ground on the passenger safety belt retractor pretensioner circuit can be caused by:

- a short to ground on circuit 30S-JA34 (RD/BK).
- a short to ground on circuit 31S-JA34 (BK/RD).
- a short to ground on the passenger safety belt retractor pretensioner.
- RCM is faulted.

PINPOINT TEST AE: LFC 18/DTC B1883 PASSENGER SAFETY BELT RETRACTOR PRETENSIONER CIRCUIT SHORTED TO GROUND

Pinpoint Test AF: B1892 Air Bag Tone Warning Indicator Circuit Shorted to Ground or Open

Normal Operation

The restraints control module (RCM) monitors its connection to the instrument cluster at C310a at pin 26. This connection is used to signal a chime if the air bag indicator is inoperative and another SRS fault exists. If the RCM detects a short to ground or open on the connection to the instrument cluster, it will store a diagnostic trouble code (DTC) B1892 in memory.

Possible Causes

An air bag tone warning indicator circuit short to ground or open can be caused by:

- a short to ground or open on circuit 8-JA13 (WH/BK).
- a damaged or inoperative instrument cluster.
- RCM is faulted.

PINPOINT TEST AF: DTC B1892 AIR BAG TONE WARNING INDICATOR CIRCUIT SHORTED TO GROUND OR OPEN

Pinpoint Test AG DTC B1891 Air Bag Tone Warning Indicator Circuit Shorted to Battery or Ignition

Normal Operation

The restraints control module (RCM) monitors its connection to the instrument cluster at pin 26. This connection is used to signal a chime if the air bag indicator is inoperative and another SRS fault exists. If the RCM detects a short to battery or ignition on the connection to the instrument cluster, it will store a diagnostic trouble code (DTC) B1891 in memory.

Possible Causes

An air bag tone warning indicator circuit short to battery or ignition can be caused by:

- a short to battery or ignition on circuit 8-JA13 (WH/BK).
- a damaged or inoperative instrument cluster.
- RCM is faulted.

PINPOINT TEST AG: DTC B1891 AIR BAG TONE WARNING INDICATOR CIRCUIT SHORTED TO BATTERY OR IGNITION

Pinpoint Test AH: DTC B1869 Air Bag Indicator Inoperative

Normal Operation

The air bag indicator is designed to illuminate for 6 (+/-2) seconds when the ignition switch is turned to the RUN position. This initial 6 seconds of illumination is considered normal operation and is called prove out of the air bag indicator. The air bag indicator is then used to warn the driver that there is a fault in the air bag supplemental restraint system (SRS).

The restraints control module (RCM) monitors the air bag indicator for open and short to ground conditions. If the RCM detects an open or short to ground condition on the air bag indicator circuit, it will store a

diagnostic trouble code (DTC) B1869 in memory.

If the RCM detects an air bag indicator failure in addition to another SRS failure, the RCM will send a signal to the air bag tone warning indicator to produce five sets of five tone bursts.

Possible Causes

An air bag indicator inoperative condition can be caused by:

- damaged wiring on circuit 31S-JA14.
- a damaged or burned out air bag indicator.
- an instrument cluster malfunction.
- RCM is faulted.

PINPOINT TEST AH: DTC B1869 AIR BAG INDICATOR INOPERATIVE

Pinpoint Test AI: DTC B1870 Air Bag Indicator Shorted to Battery

Normal Operation

The air bag indicator is designed to illuminate for 6 seconds when the ignition switch is turned to the RUN position. This is considered normal operation and is called SRS prove out . The air bag indicator is used to warn the driver that there is a fault in the (SRS).

The restraints control module (RCM) monitors the air bag indicator for short to battery conditions. If the RCM detects a short to battery condition on the air bag indicator circuit, it will store a diagnostic trouble code (DTC) B1870 in memory.

If the RCM detects an air bag indicator failure in addition to another SRS failure, the RCM will send a signal to the air bag tone warning indicator to produce five sets of five tone bursts.

Possible Causes

An air bag indicator short to battery condition can be caused by:

- damaged wiring on circuit 31S-JA14.
- an instrument cluster concern.
- RCM is faulted.

PINPOINT TEST AI: DTC B1870 AIR BAG INDICATOR SHORTED TO BATTERY

Pinpoint Test AJ: No Communication with the Restraints Control Module (RCM)

Normal Operation

The RCM communicates with the scan tool using ISO 9141 communication mode through the data link connector (DLC).

Possible Causes

A no communication condition can be caused by:

- damage to circuit 4-EE1 (GY).
- DLC connection open.
- scan tool inoperative.
- RCM is faulted.

PINPOINT TEST AJ: NO COMMUNICATION WITH THE RESTRAINTS CONTROL MODULE (RCM)

Pinpoint Test AK: LFC 5 Hz RCM in Plant Mode

Normal Operation

A new restraints control module (RCM) is programmed to flash a special code. The code is 5 Hz and is used during vehicle assembly. The code indicates that both (driver and passenger) side air bags are not installed correctly. The code will normally occur when both (and only both) of the following conditions are met:

- a new RCM is installed.
- both side air bags are not correctly installed.

Possible Causes

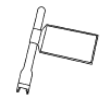
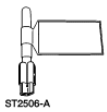
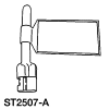
A 5 Hz LFC can be caused by:

- both front seats not installed.
- both side air bags not correctly installed.
- RCM is faulted.

PINPOINT TEST AK: PINPOINT TEST AG: LFC 5 HZ RCM IN PLANT MODE

Supplemental Restraint System (SRS) Deactivation and Reactivation

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F395 (014-R1079)
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Deactivation

⚠ WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

⚠ WARNING: The safety belt buckle pretensioner and safety belt retractor pretensioner are pyrotechnic devices. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

⚠ WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

⚠ WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.**

NOTE: Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors.

NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road.**

NOTE: After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

1. ⚠ **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

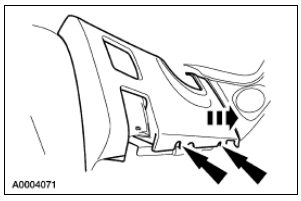
   Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

   The side air bag sensors are located at or near the base of the B-pillar.

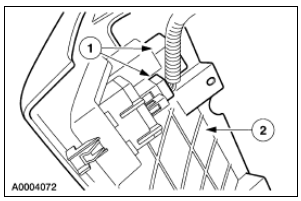
   To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

   Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

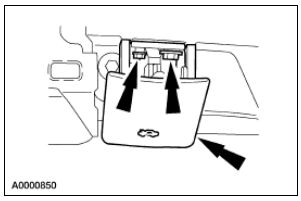
2. Remove the two screws and pull out on the lower steering column opening finish panel enough to access the electrical connectors.



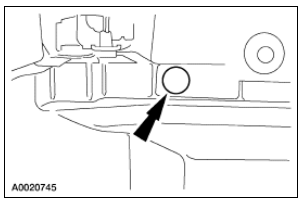
3. Remove the lower steering column opening finish panel.
   1. Disconnect the electrical connectors.
   2. Remove the lower steering column opening finish panel.



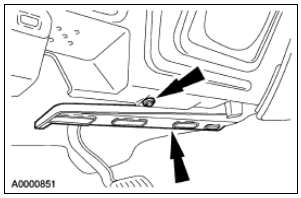
4. Remove the screws. Separate the hood latch release cable and handle assembly from the steering column opening reinforcement.



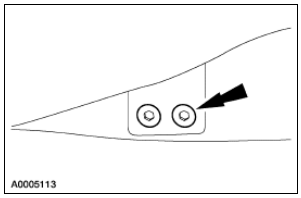
5. Remove the two pin-type retainers and the RH instrument panel insulator.
   - Disconnect the courtesy lamp.



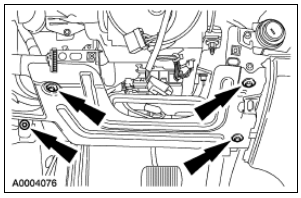
6. Remove the screw and the heater duct.



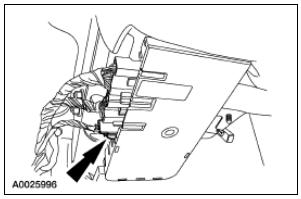
7. Loosen the two driver-side instrument panel tunnel brace bolts.
   - Position the carpet aside to gain access to the bolts.



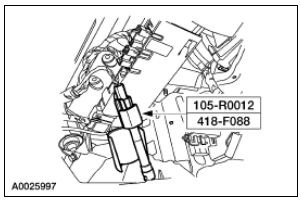
8. Remove the screws and the steering column opening reinforcement.



9. Disconnect the clockspring electrical connector at the base of the steering column.

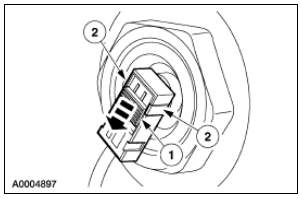


10. Attach the restraint system diagnostic tool to the vehicle harness side of the clockspring electrical connector.

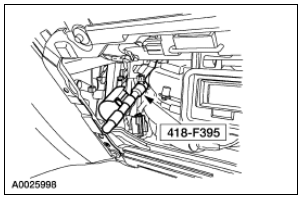


11. Remove the glove compartment. For additional information, refer to Section 501-12 .

12. Disconnect the passenger air bag module electrical connector.
    1. Reaching into the glove box opening toward the center of the instrument panel, under the cross-car beam, slide and disengage the passenger air bag module electrical connector locking clip.
    2. Push in on the two release tabs and disconnect the passenger air bag module electrical connector.



13. Attach the restraint system diagnostic tool to the vehicle harness side of the passenger air bag electrical connector.



14. Connect the battery ground cable. For additional information, refer to Section 414-01 .

15. Move and tilt the front seats to their highest and most forward position.

16. ⚠ **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

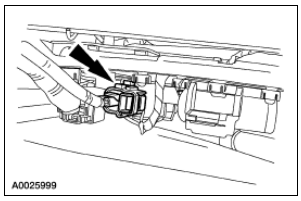
    Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

    The side air bag sensors are located at or near the base of the B-pillar.

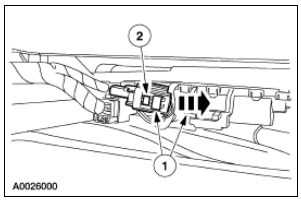
    To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

    Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

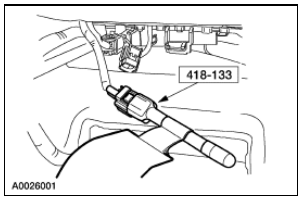
17. From under the passenger seat, release the tab on the connector bracket and remove the passenger seat side air bag electrical connector.



18. Disconnect the passenger seat side air bag electrical connector.
    1. Slide and disengage the passenger seat side air bag electrical connector locking clip.
    2. Push in to release the tab and disconnect the passenger seat side air bag electrical connector.



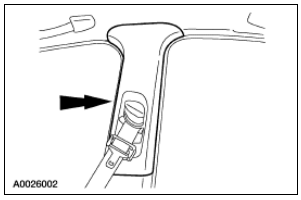
19. Attach the restraint system diagnostic tool to the passenger seat side air bag floor electrical connector.



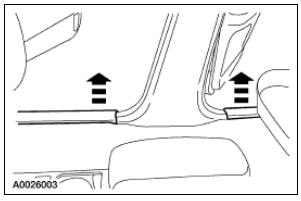
20. Remove the passenger side B-pillar weatherstripping.

21. Position the safety belt D-ring to its highest point.

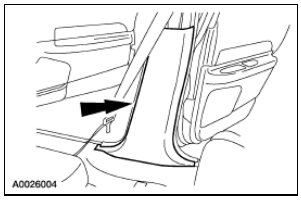
22. Remove the passenger side B-pillar upper trim panel.



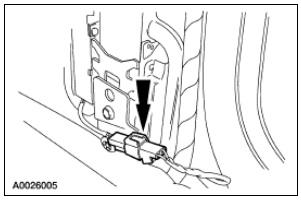
23. Remove the passenger side front and rear door scuff plates.



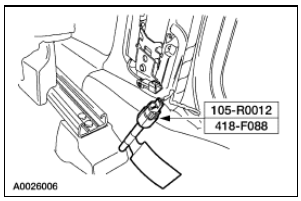
24. Remove the passenger side B-pillar lower trim panel.



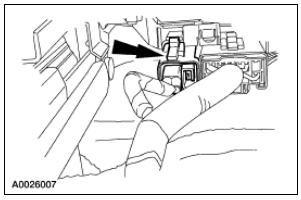
25. Disconnect the passenger side safety belt retractor pretensioner floor electrical connector.



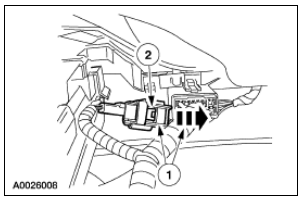
26. Attach the restraint system diagnostic tool to the passenger side safety belt retractor pretensioner floor electrical connector.



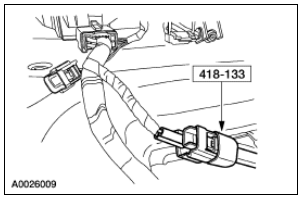
27. From under the driver seat, release the tab on the connector bracket and remove the driver seat side air bag electrical connector.



28. Disconnect the driver seat side air bag electrical connector.
    1. Slide and disengage the driver seat side air bag electrical connector locking clip.
    2. Push down to release the tab and disconnect the driver seat side air bag electrical connector.



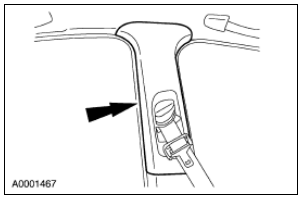
29. Attach the restraint system diagnostic tool to the driver seat side air bag floor electrical connector.



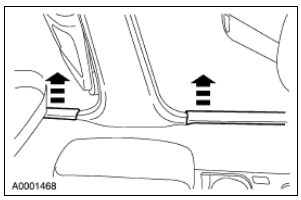
30. Remove the driver side B-pillar weatherstripping.

31. Position the safety belt D-ring to its highest point.

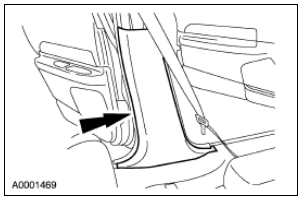
32. Remove the driver side B-pillar upper trim panel.



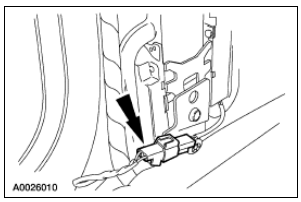
33. Remove the driver side front and rear door scuff plates.



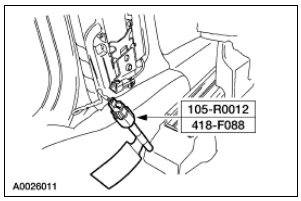
34. Remove the driver side B-pillar lower trim panel.



35. Disconnect the driver side safety belt retractor pretensioner electrical connector.



36. Attach the restraint system diagnostic tool to the driver side safety belt retractor pretensioner floor electrical connector.



37. Connect the battery ground cable. For additional information, refer to Section 414-01 .

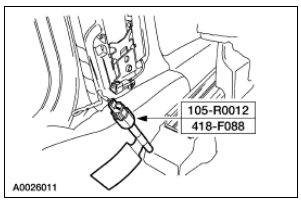
38. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.

39. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

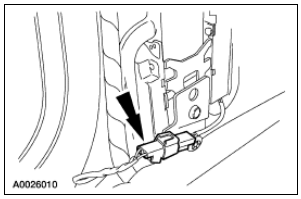
Reactivation

⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, and notes at the beginning of the deactivation procedure.

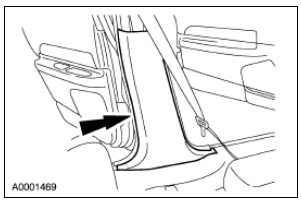
1. Remove the restraint system diagnostic tool from the driver side safety belt retractor pretensioner floor electrical connector.



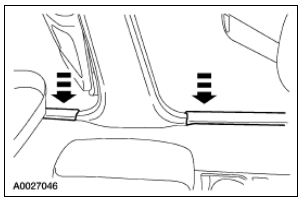
2. Connect the driver side safety belt retractor pretensioner electrical connector.



3. Install the driver side B-pillar lower trim panel.

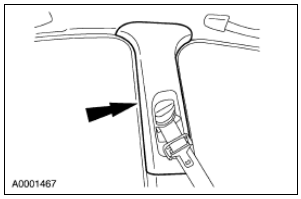


4. Install the driver side front and rear door scuff plates.



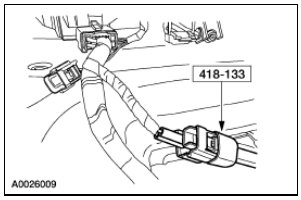
5. **NOTE:** Position the safety belt D-ring to its highest point.

   Install the driver side B-pillar upper trim panel.

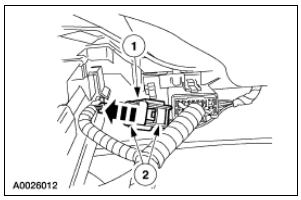


6. Install the driver side B-pillar weatherstripping.

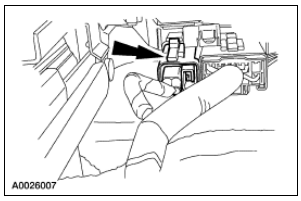
7. Remove the restraint system diagnostic tool from the driver seat side air bag floor electrical connector.



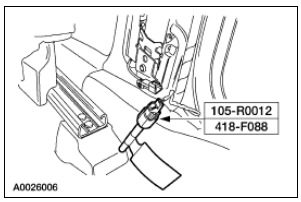
8. Connect the driver seat side air bag electrical connector.
    1. Connect the driver seat side air bag electrical connector.
    2. Slide and engage the driver seat side air bag electrical connector locking clip.



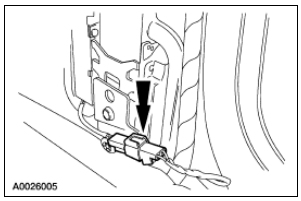
9. Install the driver seat side air bag electrical connector onto the connector bracket under the driver seat.



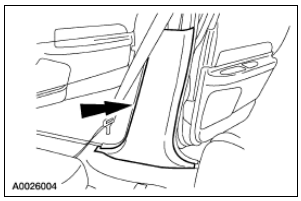
10. Remove the restraint system diagnostic tool from the passenger side safety belt retractor pretensioner electrical connector.



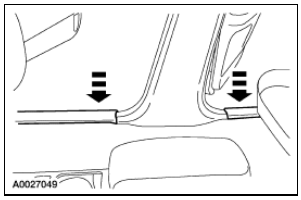
11. Connect the passenger side safety belt retractor pretensioner electrical connector.



12. Install the passenger side B-pillar lower trim panel.

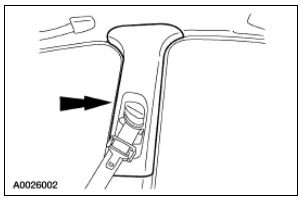


13. Install the passenger side front and rear door scuff plates.



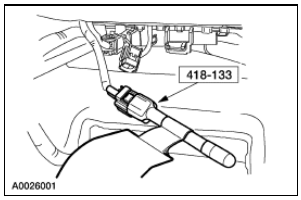
14. **NOTE:** Position the safety belt D-ring to its highest point.

    Install the passenger side B-pillar upper trim panel.

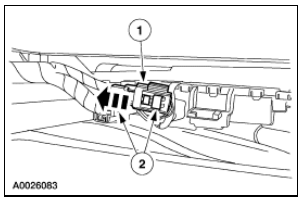


15. Install the passenger side B-pillar weatherstripping.

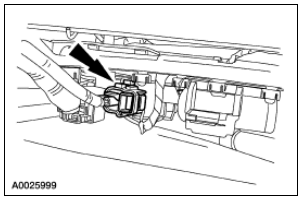
16. Remove the restraint system diagnostic tool from the passenger seat side air bag floor electrical connector.



17. Connect the passenger seat side air bag electrical connector.
    1. Connect the passenger seat side air bag electrical connector.
    2. Slide and engage the passenger seat side air bag electrical connector locking clip.



18. Install the passenger seat side air bag electrical connector onto the connector bracket under the passenger seat.



19. Connect the battery ground cable. For additional information, refer to Section 414-01 .

20. Position the front seats rearward.

21. ⚠ **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag**

supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

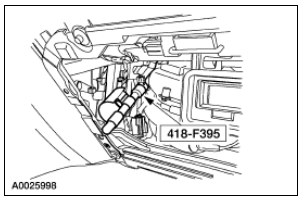
Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

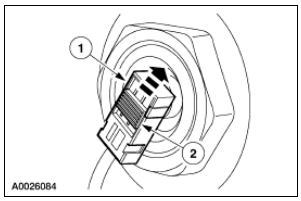
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

22. Remove the restraint system diagnostic tool from the vehicle harness side of the passenger air bag electrical connector.

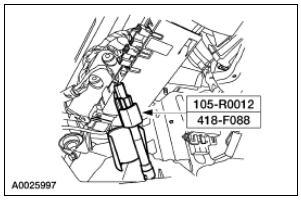


23. Connect the passenger air bag module electrical connector.
    1. Reach into the glove box opening toward the center of the instrument panel, under the cross-car beam and connect the passenger air bag module electrical connector.
    2. Slide and engage the passenger air bag module electrical connector locking clip.

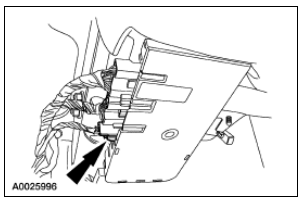


24. Install the glove compartment. For additional information, refer to Section 501-12 .

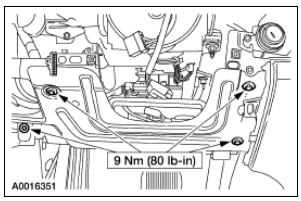
25. Remove the restraint system diagnostic tool from the vehicle harness side of the clockspring electrical connector.



26. Connect the clockspring electrical connector at the base of the steering column.



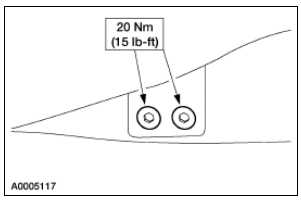
27. Position the steering column opening reinforcement and install the screws.



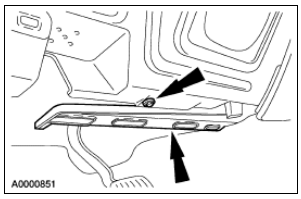
28. ⚠ **CAUTION: Be sure the steering column opening reinforcement is in place before tightening the driver-side instrument panel tunnel brace bolts.**

    Tighten the two driver-side instrument panel tunnel brace bolts.

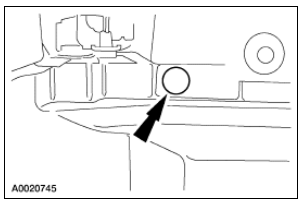
    - Reposition the carpet.



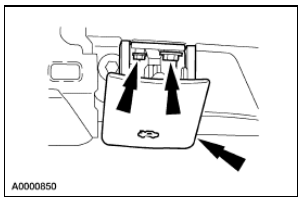
29. Position the heater duct and install the screw.



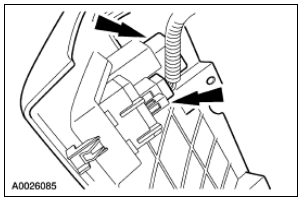
30. Install the RH instrument panel insulator and the two pin-type retainers.
    - Connect the courtesy lamp.



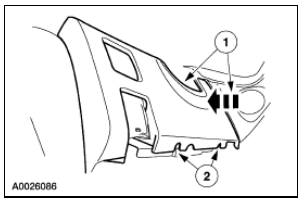
31. Position the hood latch release cable and handle assembly to the steering column opening reinforcement and install the screws.



32. Connect the electrical connectors to the switches in the lower steering column opening finish panel.



33. Install the lower steering column opening finish panel to the instrument panel.
    1. Position the lower steering column opening finish panel to the instrument panel and push in, seating the retaining clips.
    2. Install the screws.



34. Connect the battery ground cable. For additional information, refer to Section 414-01 .

35. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.

36. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Inspection and Repair After a Supplemental Restraint System (SRS) Deployment

⚠ WARNING: If the supplemental restraint system (SRS) is being serviced, the system must be deactivated and restraint system diagnostic tools must be installed. For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.

The air bag restraint system diagnostic tools must be removed and the air bag modules reconnected when the system is reactivated to avoid non-deployment in a collision, resulting in possible personal injury.

NOTE: Diagnostics or repairs are not to be carried out on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road.**

NOTE: After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

1. When any deployable device (driver air bag, passenger air bag, seat side air bag, safety belt pretensioner, etc.) or combination of devices are deployed and/or the RCM has the DTC B1231 (Crash Data Memory Full) in memory, the repair of the vehicle's supplemental restraint system (SRS) is to include the removal of all deployed devices and the installation of new deployable devices, the removal and installation of new impact sensors, and the removal and installation of a new RCM.

2. When any damage to the impact sensor mounting points or mounting hardware has occurred, repair or install new mounting points and mounting hardware as needed.

3. When the driver air bag module has deployed a new clockspring must be installed.

4. Inspect the entire vehicle for damage, including the following components:
   - steering column.
   - instrument panel knee bolsters and mounting points.
   - instrument panel braces and brackets.
   - instrument panel and mounting points.
   - seats and seat mounting points.
   - safety belts, safety belt buckles, and safety belt retractors. For additional information, refer to Section 501-20A .
   - supplemental restraint system (SRS) wiring, wiring harnesses, and connectors.

5. After carrying out the review and inspection of the entire vehicle for damage, repair or install new components as needed.

Air Bag Disposal Deployed

1. **WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.**

   Dispose of the deployed air bag modules and safety belt pretensioners in the same manner as any other part to be scrapped.

Air Bag Disposal Undeployed Inoperative

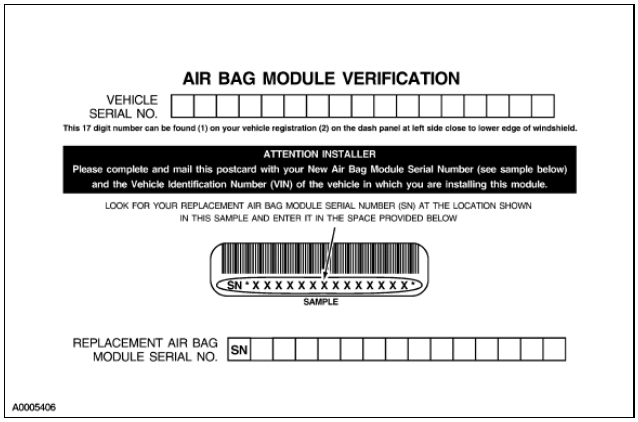
⚠ WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

⚠ WARNING: Carry a live air bag module with the air bag and trim cover or deployment door pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

NOTE: All inoperative air bag modules and safety belt pretensioners have been placed on the Mandatory Return List. All discolored or damaged air bag modules must be treated the same as any inoperative live air bag being returned.

1. Remove the inoperative component from the vehicle. For additional information, refer to the appropriate air bag procedure in this section.



2. **NOTE:** When installing a new air bag module, a prepaid return postcard is provided with the replacement air bag module. The serial number for the new part and the vehicle identification number (VIN) must be recorded and sent to Ford Motor Company.

   If installing a new air bag module, record the necessary information and return the inoperative air bag module to Ford Motor Company.

Air Bag Disposal Driver, Undeployed, Scrapped Vehicle

Remote Deployment

⚠ WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module or safety belt retractor/pretensioner assembly. This will reduce the risk of injury in the event of an accidental deployment.

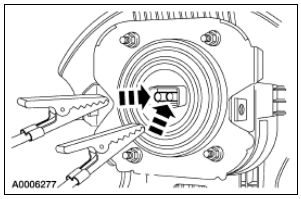
⚠ WARNING: Carry a live air bag module with the air bag and trim cover or deployment door pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Remote deployment is to be performed outdoors with all personnel at least 6.1 meters (20 feet) away to ensure personal safety. Due to the loud report which occurs when the air bag is deployed, hearing protection is required.

⚠ WARNING: Do not place the driver or passenger air bag module with the trim cover or deployment door facing down, as the forces of the deploying air bag can cause it to ricochet and cause personal injury.

1. Remove the driver air bag from the vehicle. For additional information, refer to Driver Air Bag Module in this section.

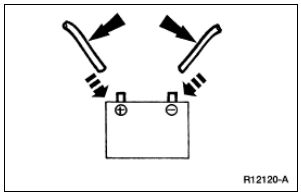
2. Obtain two wires (20 gauge minimum) at least 6.1 meters (20 feet) long and attach one end of each wire to the connector pins on the air bag module.



3. Place the air bag module on a flat surface in an open outdoor area with the trim cover facing upward.

4. Remain at least 6.1 meters (20 feet) away from the air bag module.

5. Deploy the air bag module by touching the other ends of the two wires to the terminals of a 12-volt battery.



6. To allow for cooling, wait at least ten minutes before approaching the deployed air bag.

7. Dispose of the deployed air bag module in the same manner as any other part to be scrapped.

Air Bag Disposal Passenger, Undeployed, Scrapped Vehicle

Remote Deployment

⚠ WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module or safety belt retractor/pretensioner assembly. This will reduce the risk of injury in the event of an accidental deployment.

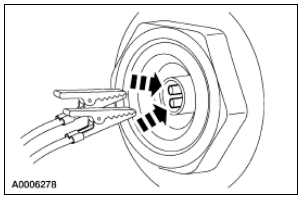
⚠ WARNING: Carry a live air bag module with the air bag and trim cover or deployment door pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Remote deployment is to be performed outdoors with all personnel at least 6.1 meters (20 feet) away to ensure personal safety. Due to the loud report which occurs when the air bag is deployed, hearing protection is required.

⚠ WARNING: Do not place the driver or passenger air bag module with the trim cover or deployment door facing down, as the forces of the deploying air bag can cause it to ricochet and cause personal injury.

1. Remove the passenger air bag from the vehicle. For additional information, refer to Passenger Air Bag Module in this section.

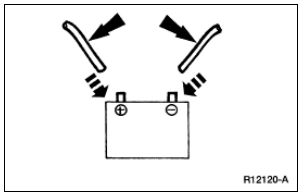
2. Obtain two wires (20 gauge minimum) at least 6.1 meters (20 feet) long and attach one end of each wire to the connector pins on the air bag module.



3. Place the air bag module on a flat surface in an open outdoor area with the deflector can facing downward.

4. Remain at least 6.1 meters (20 feet) away from the air bag module.

5. Deploy the air bag module by touching the other ends of the two wires to the terminals of a 12-volt battery.



6. To allow for cooling, wait at least ten minutes before approaching the deployed air bag.

7. Dispose of the deployed air bag module in the same manner as any other part to be scrapped.

Air Bag Disposal Side, Undeployed, Scrapped Vehicle

Remote Deployment

⚠ WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module or safety belt retractor/pretensioner assembly. This will reduce the risk of injury in the event of an accidental deployment.

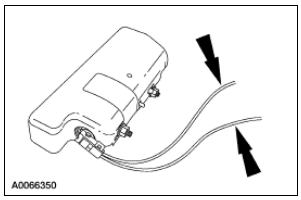
⚠ WARNING: Carry a live air bag module with the air bag and trim cover or deployment door pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Remote deployment is to be carried out outdoors with all personnel at least 6.1 meters (20 feet) away to ensure personal safety. Due to the loud report which occurs when the air bag is deployed, hearing protection is required.

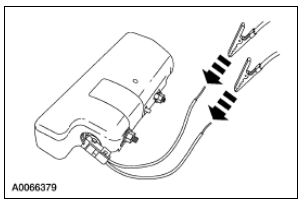
⚠ WARNING: Do not place the side air bag module with the tear seam facing down or the attaching studs facing upward, as the forces of the deploying air bag can cause it to ricochet and cause personal injury.

1. Remove the side air bag from the vehicle. For additional information, refer to Side Air Bag Module in this section.

2. Cut and strip the wires and connect the connector to the air bag module.



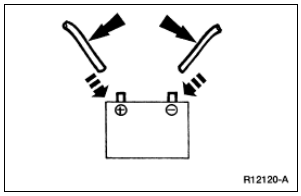
3. Obtain two wires (20 gauge minimum) at least 6.1 meters (20 feet) long and attach one end of each wire to the connector pins on the air bag module.



4. Place the air bag module on a flat surface in an open outdoor area with the tear seam facing upward and the attaching studs facing downward.

5. Remain at least 6.1 meters (20 feet) away from the air bag module.

6. Deploy the side air bag module by touching the other ends of the two wires to the terminals of a 12-volt battery.



7. To allow for cooling, wait at least ten minutes before approaching the deployed air bag.

8. Dispose of the deployed side air bag module in the same manner as any other part to be scrapped.

Safety Belt Pretensioner Disposal Deployed

1. **WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.**

   Dispose of the deployed safety belt pretensioner in the same manner as any other part to be scrapped.

Safety Belt Pretensioner Disposal Undeployed, Inoperative

⚠ WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

⚠ WARNING: Carry a live safety belt retractor pretensioner or safety belt buckle pretensioner so as to keep fingers and clothing away from moveable parts. This will reduce the risk of injury in the event of an accidental deployment.

NOTE: All inoperative safety belt buckle pretensioners and safety belt retractor pretensioners have been placed on the Mandatory Return List. All damaged safety belt buckle pretensioners and safety belt retractor pretensioners must be treated the same as any inoperative live safety belt buckle pretensioner or safety belt retractor pretensioner being returned.

1. Remove the inoperative safety belt buckle pretensioner or safety belt retractor pretensioner from the vehicle. For additional information, refer to Section 501-20A .

2. Package and return the inoperative safety belt buckle pretensioner or safety belt retractor pretensioner to Ford Motor Company.

Safety Belt Pretensioner Disposal Undeployed, Scrapped Vehicle

Remote Deployment

⚠ WARNING: The safety belt pretensioner is a pyrotechnic device. Always wear safety glasses when repairing an air bag equipped vehicle and when handling a safety belt buckle pretensioner or safety belt retractor pretensioner. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

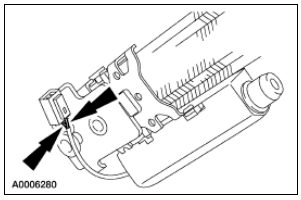
⚠ WARNING: Carry a live safety belt retractor/pretensioner assembly so as to keep fingers and clothing away from moveable parts. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Remote deployment is to be carried out outdoors with all personnel at least 6.1 meters (20 feet) away to ensure personal safety. Due to the loud report which occurs when the safety belt pretensioner is deployed, hearing protection is required.

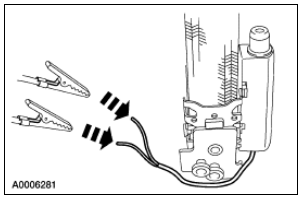
⚠ WARNING: Do not position the safety belt retractor/pretensioner assembly so that moveable parts contact the support surface, as the forces of the deploying pretensioner can cause it to ricochet and cause personal injury.

1. Remove the safety belt retractor/pretensioner assembly from the vehicle. For additional information, refer to Section 501-20A .

2. Cut off the electrical connector and strip 25 mm (1 inch) of insulation off the wires.



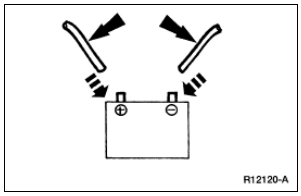
3. Obtain two wires (20 gauge minimum) at least 6.1 meters (20 feet) long and attach one end of each wire to the safety belt pretensioner wires.



4. Position the safety belt retractor/pretensioner assembly on a flat surface in an open outdoor area so that moveable parts do not contact the support surface.

5. Remain at least 6.1 meters (20 feet) away from the safety belt retractor/pretensioner assembly.

6. Deploy the safety belt pretensioner by touching the other ends of the two wires to the terminals of a 12-volt battery.



7. To allow for cooling, wait at least ten minutes before approaching the deployed safety belt pretensioner retractor/pretensioner assembly.

8. Dispose of the deployed safety belt retractor/pretensioner assembly in the same manner as any other part to be scrapped.

Wiring Repair

1. Inspect the supplemental restraint system (SRS) wiring and the wiring harness for any damage that may have occurred as a result of the accident. Inspect and repair or install new, as required, any damaged:
    - wires.
    - insulation.
    - terminal.
    - connectors.
    - splices.

2. Splice damaged wires using the specified butt-splice connector or equivalent.
    - For splices required in adjacent wiring, stagger the splices 51 mm (2 inches) apart from each other.
    - Use waterproof butt-splice type connectors.
    - Use the correct size heat shrink nylon tube to prevent water, salt, condensation, and heat from affecting the wiring repair. Make sure the tube extends 25 mm (1 inch) each side of the repair.
    - Use a splice connector that is lined with a sealer that melts when heated with a heat gun and flows from the tubing, sealing and splice.
    - Use the correct gauge connector for the wire being repaired.
    - Use connectors that are transparent to allow inspection of the finished splice.

Weld Nut Repair "J" Nut, Restraints Control Module (RCM) and Side Impact Sensor

⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side impact sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

NOTE: There are two procedures to repair a vehicle having missing restraints control module or side impact sensor attaching weld nut(s). Read both this procedure and Weld Nut Repair Missing Weld Nut, Restraints Control Module (RCM) and Side Impact Sensor before proceeding with the repair.

NOTE: If two or more weld nuts are missing, do not install the "J" nuts as outlined in this procedure. Weld nuts must be installed as outlined in Weld Nut Repair Missing Weld Nut, Restraints Control Module (RCM) and Side Impact Sensor .

NOTE: The following procedure applies to vehicles that have a rectangular hole in the sheet metal that is in close proximity to the missing weld nut.

1. Obtain a "J" nut (part number N623332-S301) or any of the following optional "J" nuts (part numbers: N623342-S101, N800854-S100, N800925-S100).

2. Obtain a 6 mm (0.24 in) grounding screw (part number N806327-S190) or equivalent.

3. Install the "J" nut through the rectangular hole in the sheet metal.

4. **NOTE:** Be sure the threaded portion of the "J" nut is aligned with the clearance hole in the sheet metal.

   Install the crash sensor.

5. Tighten the attaching screws to specification. For additional information, refer to Torque Specifications in this section.

Weld Nut Repair Missing Weld Nut, Restraints Control Module (RCM) and Side Impact Sensor

⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side impact sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

NOTE: There are two procedures to repair a vehicle having missing restraints control module or side impact sensor attaching weld nut(s). Read both this procedure and Weld Nut Repair "J" Nut, Restraints Control Module (RCM) and Side Impact Sensor before proceeding with the repair.

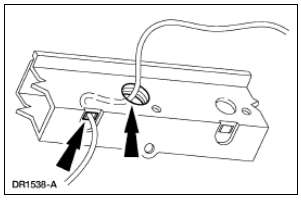
NOTE: Use only this procedure if two or more weld nuts are missing, do not install the "J" nuts as outlined in Weld Nut Repair "J" Nut, Restraints Control Module (RCM) and Side Crash Sensor.

NOTE: Radiator support repair shown, others are similar.

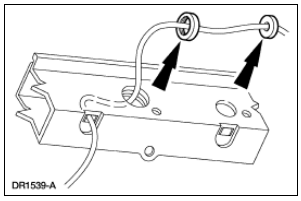
1. Obtain a 6 mm (0.24 in) weld nut (part number N806285-S190).

2. Obtain a 6 mm (0.24 in) grounding screw (part number N806327-S190).

3. Route a sufficient length of copper welding wire through the weld nut clearance hole and back out an adjacent access hole.



4. Feed the copper welding wire through the weld nut, then through a standard flatwasher.



5. Secure the flatwasher so that it cannot be pulled off the end of the copper welding wire.

6. Pull the copper welding wire back through the clearance hole, allowing the weld nut and flatwasher to follow the copper welding wire through.

7. Position the weld nut to the weld nut clearance hole, firmly pulling on the copper welding wire allowing the secured flatwasher to hold the weld nut in position.

8. Holding the weld nut securely in place and using a MIG welder, weld in four places around the edge of the weld nut.

9. Metal finish as required.

10. Verify the nut is securely in place.

11. Install the crash sensor.

12. Tighten the attaching screws to specification. For additional information, refer to Torque Specifications in this section.

Weld Nut Repair Stripped Weld Nut, Restraints Control Module (RCM) and Side Impact Sensor

⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

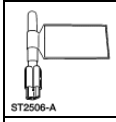
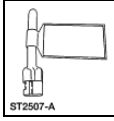
The side impact sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

1. Obtain an 8 mm (0.32 in) grounding screw (part number N802455-S190).
2. Drill out the internal threads of the stripped-out weld nut to 7.37 mm (0.29 in) using a letter "L" size drill bit.
3. Position the crash sensor to the vehicle.
4. Install the 8 mm (0.32 in) grounding screw into the drilled-out weld nut.
5. Install the remaining attaching screws.
6. Tighten the attaching screws to specification. For additional information, refer to Torque Specifications in this section.

Side Impact Sensor

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F395 (014-R1079)
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Removal

⚠ **WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.**

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

NOTE: The left side is shown, the right side is similar.

1. Prepare the vehicle for side impact sensor removal.
    1. ⚠ **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

       Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

       The side air bag sensors are located at or near the base of the B-pillar.

       To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

       Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .
    2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

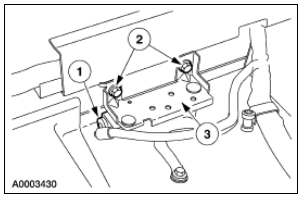
Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section.

3. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

   Remove the seat on the side with the affected side impact sensor. For additional information, refer to Section 501-10 .

2. Position the carpet away from the B-pillar.

3. Remove the side impact sensor.
   1. Disconnect the side impact sensor electrical connector.
   2. Remove the bolts.
   3. Remove the side impact sensor with bracket.



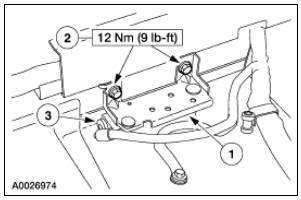
Installation

⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.**

1. ⚠ **WARNING: The tightening torque of the air bag side impact sensor retaining bolts is critical for proper system operation.**

   Install the side impact sensor.

   1. Position the side impact sensor with bracket.
   2. Install the bolts.
   3. Connect the side impact sensor.



2. Connect the battery ground cable. For additional information, refer to Section 414-01 .

3. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) , in the Diagnosis and Testing portion of this section.

4. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

5. Reposition the carpet back at the B-pillar.

6. Restore the vehicle to operating condition.
    1. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

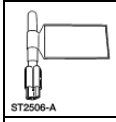
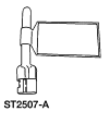
       Install the seat on the side with the affected side impact sensor. For additional information, refer to Section 501-10 .
    2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

       Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section.
    3. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

       With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section.
    4. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Restraints Control Module (RCM)

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F395 (014-R1079)
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Removal

⚠ WARNING: The restraints control module (RCM) orientation is critical for proper air bag supplemental restraint system (SRS) operation. If a vehicle equipped with an SRS system has been involved in a collision in which the center tunnel area has been damaged, inspect the mounting and bracket for deformation. If damaged, the RCM must be replaced whether or not the air bags have deployed. In addition, make sure the area of the RCM mounting is restored to its original condition.

⚠ WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

⚠ CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage can result.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

All vehicles

1. Prepare the vehicle for restraints control module (RCM) removal.
    1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

       Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

       The side air bag sensors are located at or near the base of the B-pillar.

       To deplete the backup power supply energy, disconnect the battery ground cable and

wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

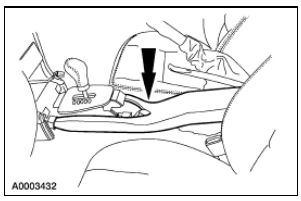
Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

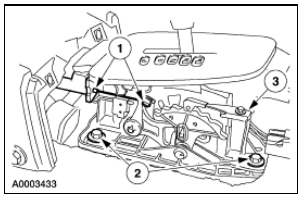
2. Remove the center console. For more information, refer to Section 501-12 .

3. Remove the rear vent duct.



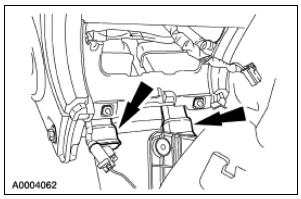
Vehicles with automatic transmission

4. Position the shifter out of the way.
   1. Disconnect and separate the shifter interlock cable and casing from the shifter.
   2. Remove the shifter retaining bolts (two shown).
   3. Position the shifter out of the way.



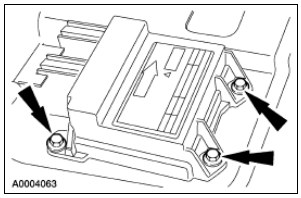
All vehicles

5. Remove the extension duct.

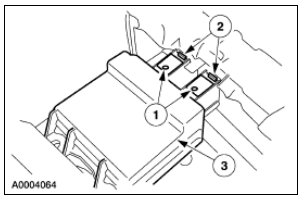


6. **NOTE:** The instrument panel has been removed for clarity.

   Remove the bolts.



7. Remove the RCM.
    1. Slide and disengage the RCM electrical connector locking clips.
    2. Depressing the locking tab, disconnect the RCM electrical connectors.
    3. Remove the RCM.



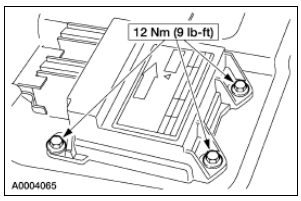
Installation

⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

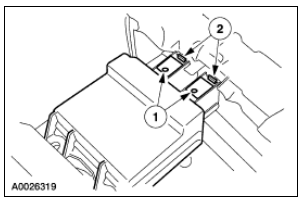
All vehicles

1. **⚠ WARNING: The tightening torque of the air bag restraints control module (RCM) retaining bolts is critical for correct system operation.**

   Position the RCM. Install the bolts.



2. Connect the RCM electrical connector.
    1. Connect the RCM electrical connectors.
    2. Slide and engage the RCM electrical connector locking clips.

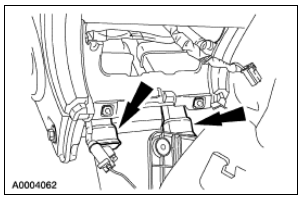


3. Connect the battery ground cable. For additional information, refer to Section 414-01 .

4. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) , in the Diagnosis and Testing portion of this section.

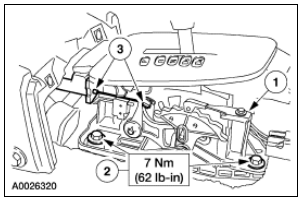
5. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

6. Install the extension duct.



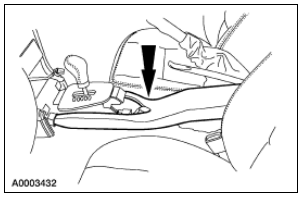
Vehicles with automatic transmission

7. Install the shifter.
    1. Position the shifter.
    2. Install the shifter bolts (two shown).
    3. Connect the shifter interlock cable and casing to the shifter.



All vehicles

8. Install the rear vent duct.



9. Install the center console. For additional information, refer to Section 501-12 .

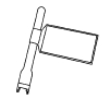
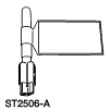
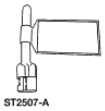
10. Restore the vehicle to operating condition.
    1. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

       Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
    2. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

       With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.

Driver Air Bag Module

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Removal

⚠ WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

⚠ WARNING: Air bag modules with discolored or damaged trim covers must be replaced, not repainted.

NOTE: A repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. Prepare the vehicle for driver air bag module removal.
    1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

       Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

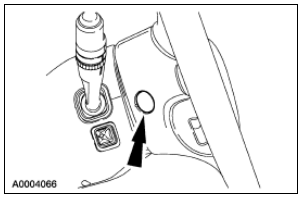
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

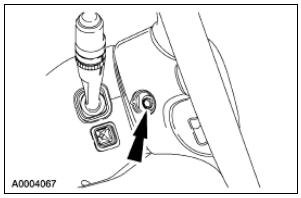
2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

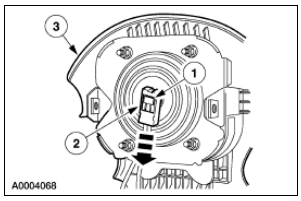
2. Remove the two steering wheel plugs.



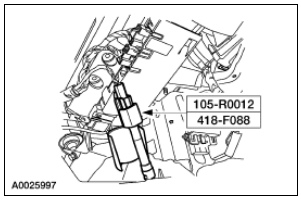
3. Remove the two driver air bag module retaining bolts.



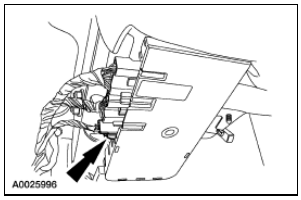
4. Disconnect and remove the driver air bag module.
   1. Slide and disengage the driver air bag electrical connector locking clip.
   2. Depress the locking tabs and disconnect the driver air bag module electrical connector.
   3. Remove the driver air bag module.



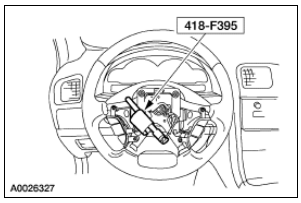
5. Remove the restraint system diagnostic tool from the vehicle harness side of the clockspring electrical connector at the base of the steering column.



6. Connect the clockspring electrical connector at the base of the steering column.



7. Attach the restraint system diagnostic tool to the clockspring electrical connector at the top of the steering column.



8. Connect the battery ground cable. For additional information, refer to Section 414-01 .

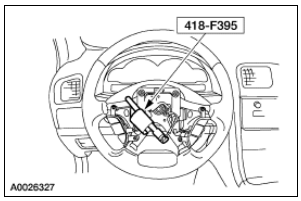
9. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.

10. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

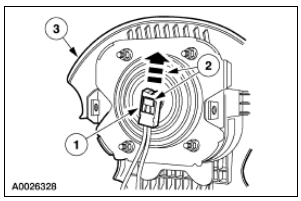
Installation

⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

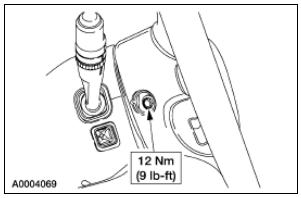
1. Remove the restraint system diagnostic tool from the clockspring electrical connector at the top of the steering column.



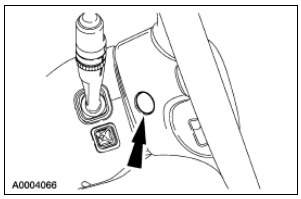
2. Connect and position the driver air bag module to the steering wheel.
    1. Connect the driver air bag module electrical connector.
    2. Slide and engage the driver air bag module electrical connector locking clip.
    3. Position the driver air bag module to the steering wheel.



3. Install the two driver air bag module bolts.



4. Install the two steering wheel back cover plugs.



5. Connect the battery ground cable. For additional information, refer to Section 414-01 .

6. With the restraint system diagnostic tools still installed at the remaining deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.

7. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

   Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

   The side air bag sensors are located at or near the base of the B-pillar.

   To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

   Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

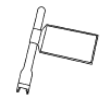
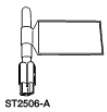
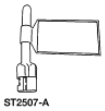
8. Restore the vehicle to operating condition.
   1. **⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

      Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
   2. **⚠ WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

      With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.

Passenger Air Bag Module

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F395 (014-R1079)
 ST2506-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Removal

⚠ WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Do not set a live air bag module with the trim cover in the face down position. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

⚠ WARNING: If the air bag module is discolored or damaged it must be replaced, not repaired.

NOTE: A repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

1. Prepare the vehicle for passenger air bag module removal.
    1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

       Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

       The side impact sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

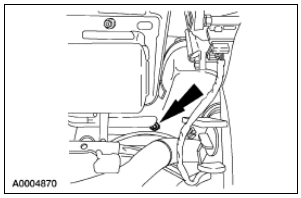
2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section.

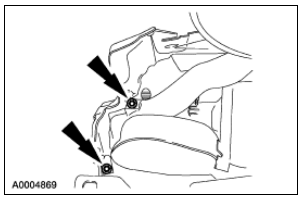
2. Remove the instrument panel. For additional information, refer to Section 501-12 .

3. Position the instrument panel face down on the bench.
   - Cover the work area with something clean and nonabrasive to protect the instrument panel.

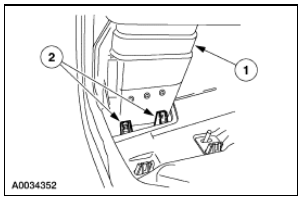
4. Remove the screw for the passenger side A/C duct near the center of the instrument panel.



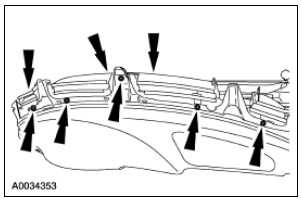
5. Remove the screws from the passenger side A/C and demister duct.



6. Remove the passenger side air conditioning register.
   1. Separate the A/C duct from the register.
   2. Push in on the retaining clips and remove the passenger side air conditioning register.

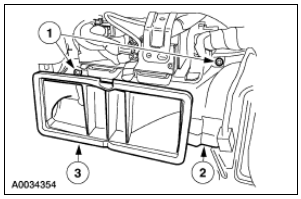


7. Remove the eight screws. Separate the driver side demister duct and remove the defrost nozzle.



8. Remove the plenum chamber. For additional information, refer to Section 412-01 .

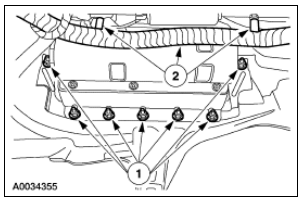
9. Remove the center A/C duct.
    1. Remove the screws.
    2. Pull out on the center A/C duct, separating the passenger A/C duct.
    3. Remove the center A/C duct.



10. **NOTE:** If installing a new passenger air bag module, install new retaining nuts and bolts.

    Remove the passenger air bag module nuts.

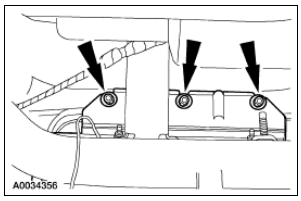
    1. Remove the passenger air bag module nuts.
    2. Release the three retainers and position the wire harness out of the way.



11. **NOTE:** If installing a new passenger air bag module, install new retaining nuts and bolts.

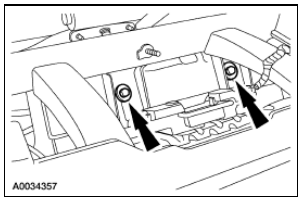
    Remove the passenger air bag module nuts.

    - Position the passenger side A/C duct out of the way to access the passenger air bag nuts.



12. **NOTE:** If installing a new passenger air bag module, install new retaining nuts and bolts.

    Remove the passenger air bag module bolts.



13. Remove the passenger air bag module through the back of the instrument panel.

Installation

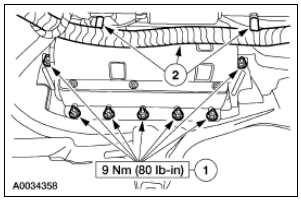
⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

1. Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

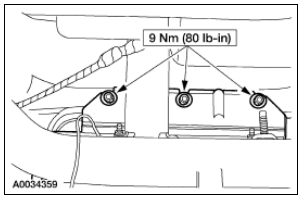
2. **NOTE:** If installing a new passenger air bag module, install new retaining nuts and bolts.

   Position the passenger air bag module to the instrument panel. Start all nuts and bolts by hand. Do not tighten at this time.

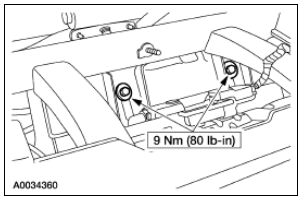
3. Tighten the passenger air bag module nuts.
   1. Tighten the passenger air bag module nuts to specification.
   2. Route the wire harness. Install the retainers.



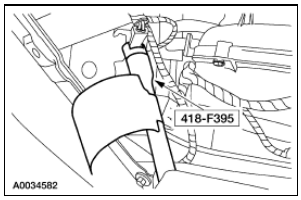
4. Tighten the passenger air bag module nuts to specification.
   - Position the glove box and passenger side A/C duct out of the way to access the passenger air bag nuts.



5. Tighten the passenger air bag module bolts.



6. Remove the restraint system diagnostic tool from the vehicle harness side of the passenger air bag module electrical connector.

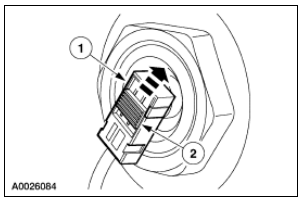


7. **NOTE:** The passenger air bag module is shown with instrument panel removed for clarity.

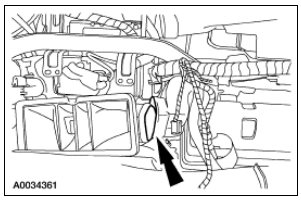
   This is a blind operation due to the passenger air bag module electrical connector mounting location.

   Connect the passenger air bag module electrical connector (this is a blind operation).

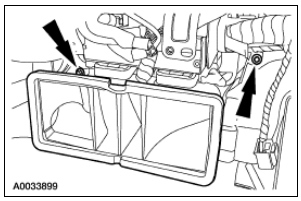
1. Connect the passenger air bag module electrical connector.
2. Slide and engage the driver air bag module electrical connector locking clip.



8. Position the center A/C duct into the passenger A/C duct.

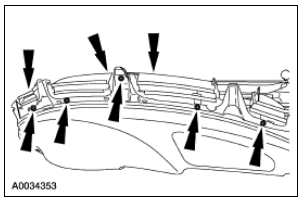


9. Position the center A/C duct to the instrument panel. Install the screws.

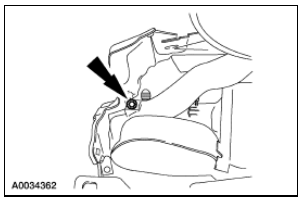


10. Install the plenum chamber. For additional information, refer to Section 412-01 .

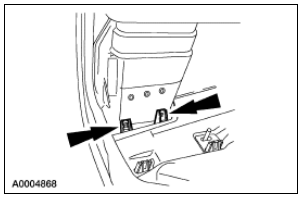
11. Position the defrost nozzle to the instrument panel while installing the driver side demister duct. Install the eight screws.



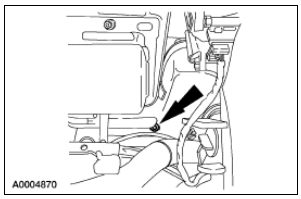
12. Position the passenger side demister duct to the instrument panel. Install the screw.



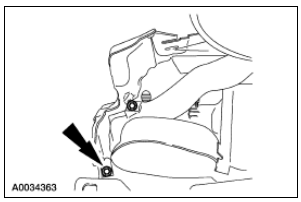
13. Install the passenger side air conditioning register into the instrument panel and engage the retaining clips.
    - Attach the passenger side air conditioning duct to the register.



14. Position the A/C duct and install the screw near the center of the instrument panel.



15. Install the screw for the A/C duct near the passenger register.



16. Install the instrument panel. Do not install the driver air bag module at this time. For additional information, refer to Section 501-12 .

17. Install the glove compartment. For additional information, refer to Section 501-12 .

18. Connect the battery ground cable. For additional information, refer to Section 414-01 .

19. With the restraint system diagnostic tools still installed at the remaining deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section.

20. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

    Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

    The side impact sensors are located at or near the base of the B-pillar.

    To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

    Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

21. **⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the driver air bag module procedure.**

Install the driver air bag module. For additional information, refer to Driver Air Bag Module in this section.

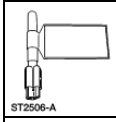
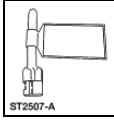
22. Restore the vehicle to operating condition.
    1. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

       Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in the General Procedures portion of this section.
    2. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

       With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in the Diagnosis and Testing portion of this section.

Side Air Bag Module

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F395 (014-R1079)
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Removal

⚠ WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Carry a live side air bag module with the air bag and tear seam pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Do not set a live side air bag module down on the cover tear seam. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

⚠ WARNING: Side air bag modules with damaged covers must be replaced.

NOTE: If a side air bag deployment took place the seat back pad, trim cover, and side air bag module must be replaced. The seat back frame should be replaced if necessary.

NOTE: When replacing the side air bag after deployment, refer to Section 501-10 for additional information concerning the installation of a new side air bag.

NOTE: Repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

NOTE: The passenger seat is shown, the driver seat is similar.

1. Prepare the vehicle for side air bag module removal.
    1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side**

air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
3. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

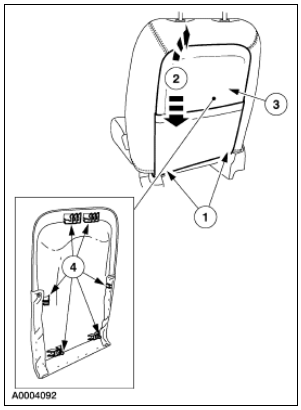
   Remove the seat on the side with the affected side air bag module. For additional information, refer to Section 501-10 .

2. ⚠ **WARNING: Front seat back trim covers installed on seats equipped with side air bags cannot be repaired, they are to be replaced (cleaning is permissible).**

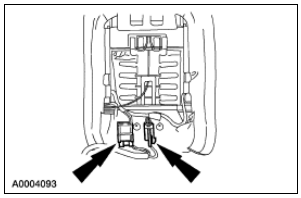
   ⚠ **CAUTION: When removing the seat back trim panel, be careful not to damage the J-hooks. If the seat back trim panel J-hooks are damaged, install a new seat back trim panel.**

   Remove the seat back trim panel.

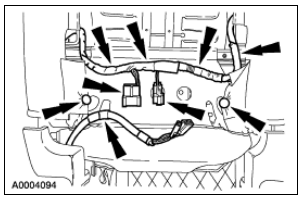
   1. Pull and release the pin-type retainers at the bottom of the seat back trim panel.
   2. While pushing in at the top of the seat back trim panel, slide it down to disengage the J-hooks.
   3. Pull out evenly at the top of the seat back trim panel and remove it.
   4. Inspect the seat back trim panel J-hooks and pin-type retainers for damage.



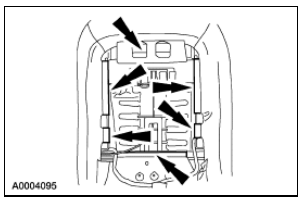
3. Disconnect the electrical connectors.



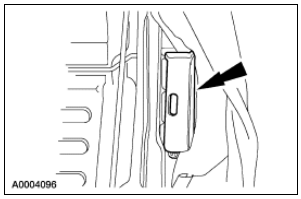
4. Separate the pin-type retainers from the seat back frame as indicated.



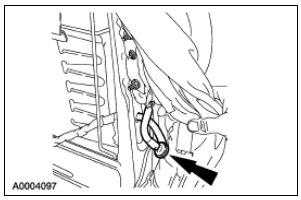
5. Detach the seat back trim cover J-clips.



6. Reposition the seat back trim cover and pad and remove the side air bag module retaining nut cover.

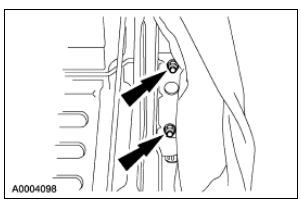


7. Push the wire harness and grommet through the seat back frame.

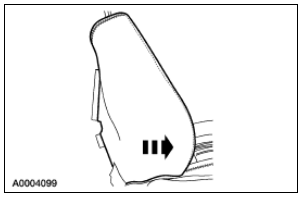


8. **NOTE:** If installing a new side air bag module, use new retaining nuts. If the same side air bag module is to be reused then reuse the side air bag module nuts.

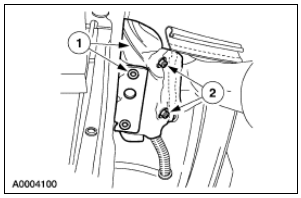
   Remove the side air bag module retaining nuts.



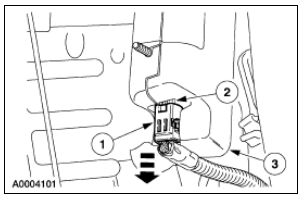
9. With one hand on the side air bag module, position the seat back trim cover and pad forward enough to access the side air bag module.



10. Remove the side air bag module from the deployment chute.
    1. Separate the side air bag module and deployment chute from the seat back mounting bracket.
    2. Pull the side air bag module mounting studs back through the deployment chute openings and remove the side air bag module from the deployment chute.



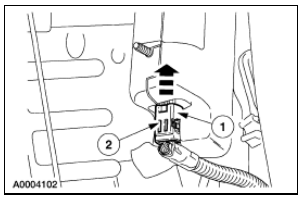
11. Remove the side air bag module.
    1. Slide the side air bag electrical connector locking clip to disengage it.
    2. Release the two connector tabs (one shown) by pushing in on them and disconnect the side air bag module.
    3. Remove the side air bag module.



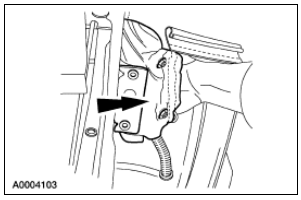
Installation

⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

1. Connect the side air bag module electrical connector.
    1. Install the connector to the side air bag module.
    2. Slide the side air bag module electrical connector locking clip to secure the connector to the side air bag module.



2. Make sure the electrical connector is securely fastened to the side air bag module.



3. **⚠ WARNING: Inspect the mounting surfaces of the side air bag module for any foreign objects before installing the side air bag module. If any foreign objects are found, remove them. Failure to do so may result in personal injury, in the event of an air bag deployment.**

   ⚠ WARNING: Inspect the side air bag deployment chute and the side air bag cavity in the seat back pad for any foreign objects. If any foreign objects are found remove them. Failure to do so may result in personal injury, in the event of an air bag deployment.

   ⚠ WARNING: Before installing the side air bag module into the deployment chute, check it for damage and foreign objects. If the air bag module is damaged, replace it. If any foreign objects are found, remove them. Failure to do so may result in personal injury, in the event of an air bag deployment.

   ⚠ WARNING: If the air bag cover has separated or the air bag material has been exposed, install a new side air bag module. Do not attempt to repair the air bag module. Failure to do so may result in personal injury, in the event of an air bag deployment.

   ⚠ WARNING: Check the side air bag deployment chute for damage. The deployment chute must not be repaired. If there is any damage to the deployment chute, the seat back trim cover and deployment chute must be installed new as a unit.

   ⚠ WARNING: If the air bag deployment chute is not properly positioned, the side air bag may not deploy properly.

   NOTE: The alignment pin will only allow the side air bag module to be installed to the seat back mounting bracket one way.

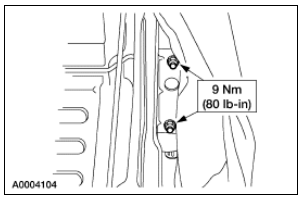
   Position the side air bag module into the deployment chute.

   - Position the side air bag module into the deployment chute with the alignment pin offset to the top and the electrical connector to the bottom of the seat back. This will position the alignment pin correctly when the side air bag module and deployment chute are mounted to the seat back frame mounting bracket.
   - The side air bag module mounting studs must come through the deployment chute stud openings.

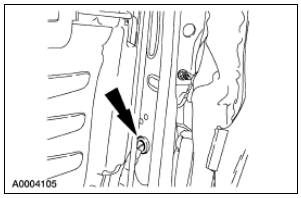
4. **⚠ WARNING: Inspect the mounting surfaces of the deployment chute and the seat back frame mounting bracket for any foreign objects, before installing the side air bag module/deployment chute assembly. If any foreign objects are found, remove them. Failure to do so may result in personal injury, in the event of an air bag deployment.**

   Install the side air bag module onto the front seat back frame mounting bracket. Install the nuts.

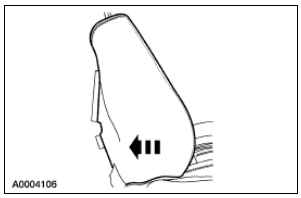
   - The deployment chute should not have any wrinkles or folds where it contacts the seat back frame mounting bracket.



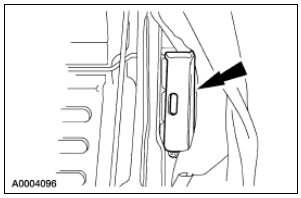
5. Pull the wire harness back through the hole in the seat back frame and seat the grommet.



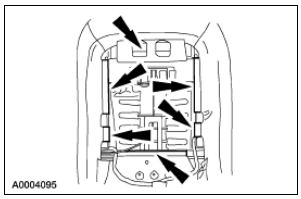
6. Reposition the seat back pad and trim cover to the seat back frame.



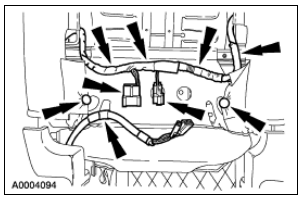
7. Attach the side air bag retaining nuts cover.
   - Check that all three attaching clips on the side air bag nuts cover are correctly installed around the side air bag mounting bracket.



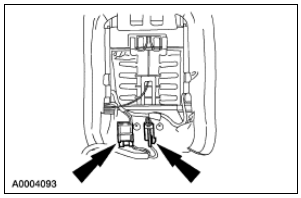
8. Fasten the seat back trim cover J-clips.



9. Install the pin-type retainers indicated.



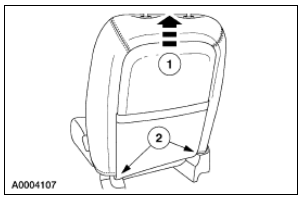
10. Connect the electrical connectors.



11. ⚠ **CAUTION: Inspect the seat back trim panel J-hooks for damage. If damaged, install a new seat back trim panel.**

    Install the seat back trim panel.

1. Angle the top of the seat back trim panel inward and up to engage the upper J-hooks to the seat back frame.
2. While holding the seat back trim panel up, align the pin-type retainers at the bottom of the seat back trim panel and install them into the seat back frame.



12. Restore the vehicle to operating condition.
    1. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the seat removal and installation procedure.**

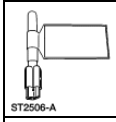
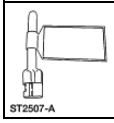
       Install the seat on the side with the affected side air bag. For additional information, refer to Section 501-10 .
    2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

       Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
    3. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

       With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.
    4. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Clockspring

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (2 Req'd) 418-F395 (014-R1079)
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Removal

⚠ WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

⚠ WARNING: Air bag modules with discolored or damaged trim covers must be replaced, not repainted.

NOTE: A repair is made by installing a new part only. If the new part does not correct the condition, install the original part and perform the diagnostic procedure again.

All vehicles

1. Prepare the vehicle for clockspring removal.
    1. **⚠ WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

       Please refer to the appropriate vehicle shop manual to determine location of the front

air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

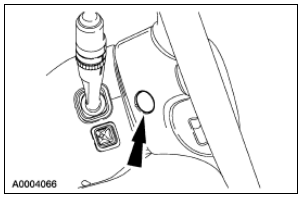
To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable (14301) and wait at least one minute. For additional information, refer to Section 414-01 .

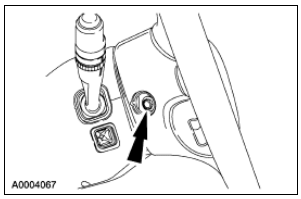
2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

   Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

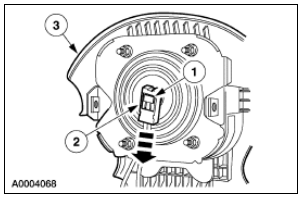
2. Remove the two steering wheel back cover plugs.



3. Remove the two driver air bag module bolts.



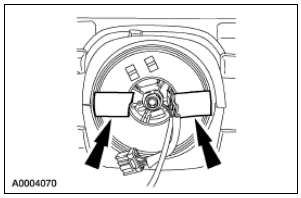
4. Remove the driver air bag module.
   1. Slide and disengage the driver air bag module electrical connector locking clip.
   2. Depressing the locking tabs, disconnect the driver air bag module electrical connector.
   3. Remove the driver air bag module.



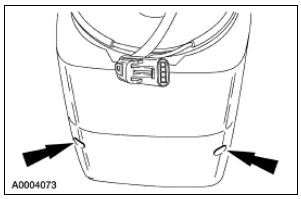
5. **NOTE:** Make sure the wheels are in the straight-ahead position.

   Remove the steering wheel. For additional information, refer to Section 211-04 .

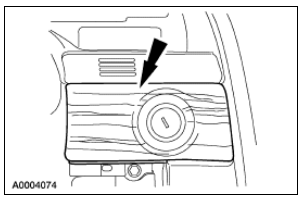
6. Apply two strips of masking tape across the clockspring to prevent accidental rotation when the clockspring is removed.



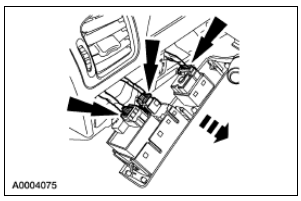
7. Remove the two screws and the lower steering column shroud.



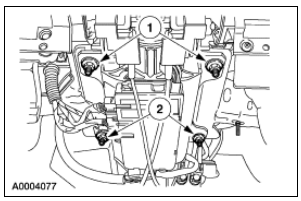
8. Pull out and remove the ignition switch finish panel.



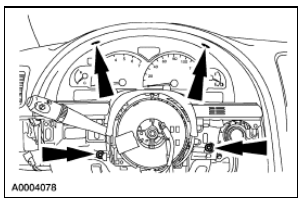
9. Remove the headlight switch finish panel by pulling out on it enough to disconnect the electrical connectors and remove it.



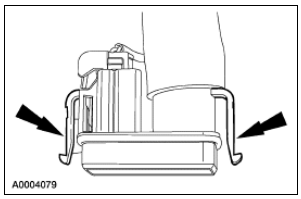
10. Lower the steering column.
    1. Remove the two steering column retaining nuts.
    2. Loosen the two steering column retaining nuts enough to pivot the steering column and remove the instrument cluster finish panel.



11. Remove the screws and the instrument cluster finish panel enough to access the automatic temperature control sensor assembly.

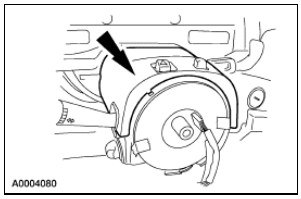


12. Separate the automatic temperature control sensor assembly from the instrument cluster finish panel by pushing in and releasing the tabs.



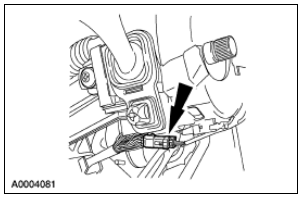
13. Remove the instrument cluster finish panel.

14. Remove the upper steering column shroud.



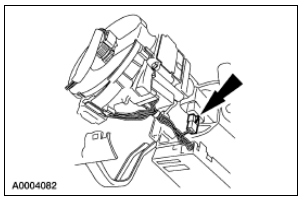
Vehicles with hands free microphone

15. Disconnect the microphone electrical connector.

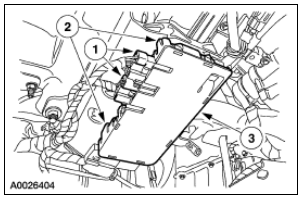


All vehicles

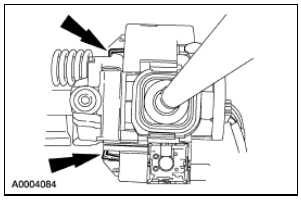
16. Disconnect the steering column position sensor electrical connector.

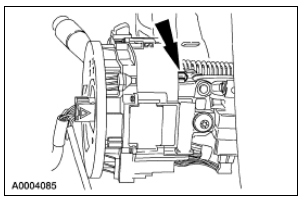


17. Separate the clockspring electrical connector assembly from the steering column.
    1. Disconnect the remaining clockspring electrical connectors.
    2. Release the four clockspring connector assembly retaining clips (two shown).
    3. Separate the clockspring electrical connector assembly from the steering column.

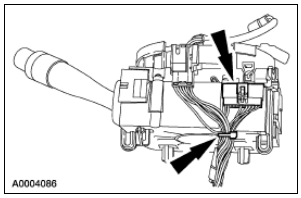


18. Releasing the three clips, remove the clockspring with the multi-function switch.

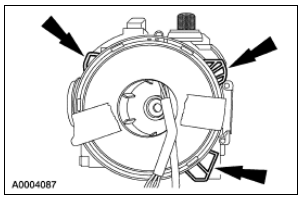




19. Cut the tie strap. Disconnect the electrical connector.



20. Releasing the tabs, separate the clockspring from the multi-function switch.

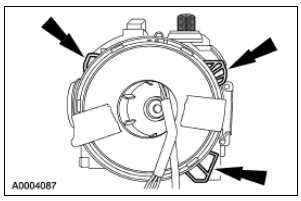


Installation

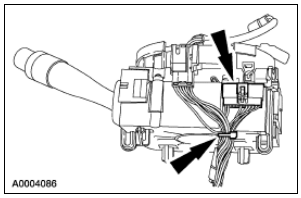
⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions and notes at the beginning of the removal procedure.

All vehicles

1. Align the clockspring to the multi-function switch and attach the two, engaging the retaining tabs.



2. Connect the electrical connector. Install a new tie strap to secure the wire harness.

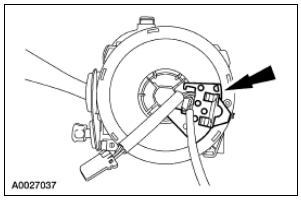


Vehicles receiving a new clockspring

3. **NOTE:** A new clockspring is supplied in a centralized position and held there with a key.

   Remove the key from the clockspring, holding the rotor in its centralized position.

   - Do not allow the clockspring rotor to turn from this position.



Vehicles needing clockspring recentering

4. **⚠ WARNING: Incorrect centralization may result in premature component failure. If in doubt when centralizing the clockspring, repeat the centralizing procedure. Failure to follow this instruction may result in personal injury.**

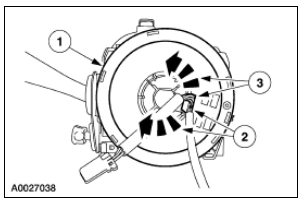
   ⚠ CAUTION: Make sure the road wheels are in the straight ahead position.

   NOTE: If a clockspring has rotated out of center, follow through with this step.

   Centralize the clockspring.

   1. Hold the clockspring outer housing stationary.
   2. **⚠ CAUTION: Overturning will destroy the clockspring. The internal ribbon wire acts as the stop and can be broken from its internal connection.**

      While turning the rotor clockwise, carefully feel for the ribbon wire to run out of length, and a slight resistance is felt. Stop turning at this point.
   3. Turn the rotor counterclockwise 2-1/2 turns. This is the center point of the clockspring.
      - ♦ Do not allow the rotor to turn from this position.



Vehicle repairs reusing the same clockspring

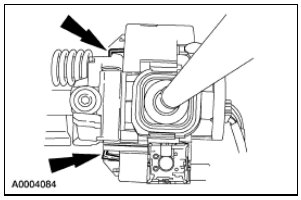
5. **NOTE:** When the tape is removed, do not allow the clockspring to turn.

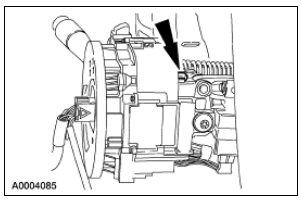
   Remove the tape applied during clockspring removal.

All vehicles

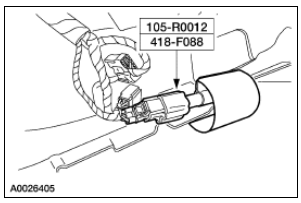
6. **NOTE:** Slight turning of the clockspring rotor is allowable for alignment purposes to the steering column.

   With the flats of the clockspring aligned to the flats of the steering column, slide the clockspring onto the steering column engaging the retaining tabs.

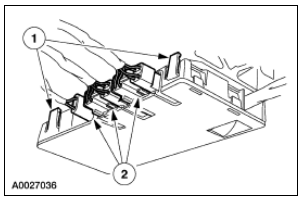




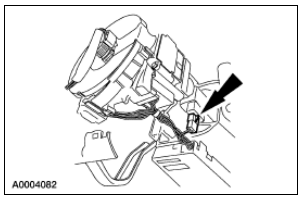
7. Remove the restraint system diagnostic tool from the vehicle harness side of the clockspring electrical connector.



8. Install and connect the clockspring electrical connector assembly.
    1. Align the clockspring electrical connector assembly to the steering column and engage the four retaining tabs (two shown).
    2. Connect the clockspring electrical connector assembly electrical connectors.

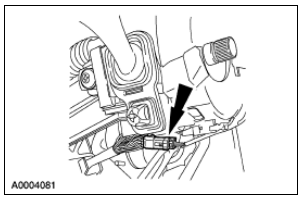


9. Connect the steering column position sensor electrical connector.



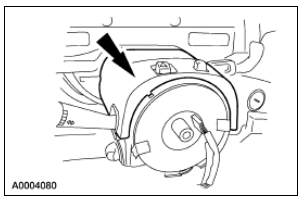
Vehicles with hands free microphone

10. Connect the microphone electrical connector.

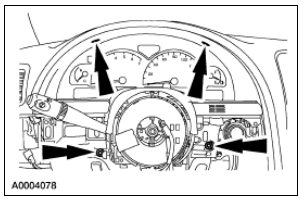


All vehicles

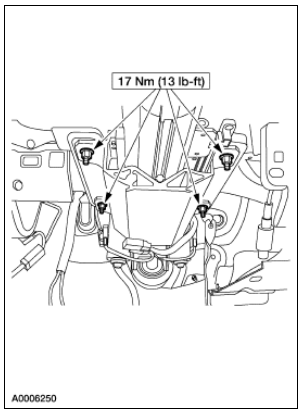
11. Position the upper steering column shroud.



12. Align the instrument cluster finish panel to the instrument panel and install the four screws.
    - Install the automatic temperature sensor to the instrument cluster finish panel (not shown).

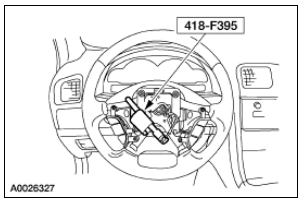


13. Install the nuts.



14. Install the steering wheel. Do not install the driver air bag module at this time. For additional information, refer to Section 211-04 .

15. Attach the restraint system diagnostic tool to the clockspring electrical connector at the top of the steering column.

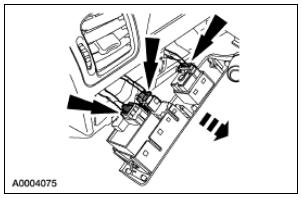


16. Connect the battery ground cable. For additional information, refer to Section 414-01 .

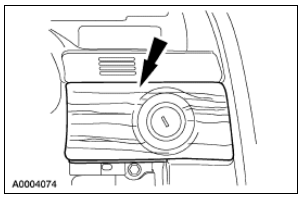
17. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.

18. Disconnect the battery ground cable and wait at least one minute. For additional information, refer to Section 414-01 .

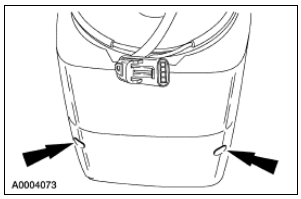
19. Connect the electrical connectors. Aligning the retaining clips, install the headlight switch panel.



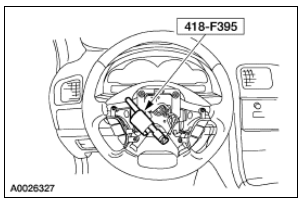
20. Align the ignition switch finish panel and push in, seating the retaining clips.



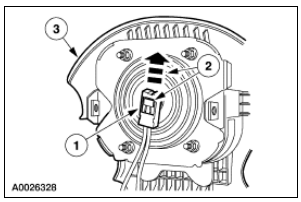
21. Position the lower steering column shroud. Install the screws.



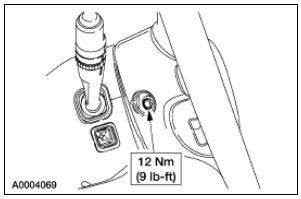
22. Remove the restraint system diagnostic tool from the clockspring electrical connector at the top of the steering column.



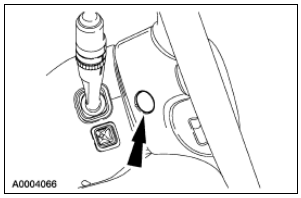
23. Connect and position the driver air bag module to the steering wheel.
    1. Connect the driver air bag module electrical connector.
    2. Slide and engage the driver air bag module electrical connector locking clip.
    3. Position the driver air bag module to the steering wheel.



24. Install the two driver air bag module bolts.



25. Install the two steering wheel back cover plugs.



26. Restore the vehicle to operating condition.
    1. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes, and instructions in the supplemental restraint system (SRS) deactivation/reactivation procedure.**

       Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
    2. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from the vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

       With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS) in this section.

General Specifications

Item	Specification
Fluid/Lubricant Specification	
Premium Life Long Grease XG-1-K	ESA-M1C75-B

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C and power steering bracket bolts	10		89
Balance nuts	24	18	
Center bearing bracket bolts	40	30	
Control arm cam nuts	175	129	
Driveshaft yoke adjuster	90	66	
Engine crossmember bolts	103	76	
Engine mount nuts	63	46	
Flex coupling bolts	85	63	
Flex coupling nuts	85	63	
Front brake capiler bolts	35	26	
Front I-brace bolts (front)	55	41	
Front I-brace bolts (rear)	30	22	
Front I-brace bracket shoulder bolt	30	22	
Front strut mount bolts	175	129	
Power steering gear bolts	103	76	
Radiator support crossmember bolts	103	76	
Rear anti-lock brake sensor bolts	9		80
Rear brake hose bolts	47	35	
Rear shock mount bolts	133	98	
Rear subframe bolts	103	76	
Stabilizer bar bolts	55	41	
Stabilizer bar link nuts	55	41	
Tie rod end nuts	80	59	
Upper ball joint nuts	90	66	
Water control valve bracket nuts	9		80

Body Misalignment Check

⚠ **CAUTION: Do not attempt to correct any serious misalignment with one pulling/pushing operation. Damage to the structure could occur.**

NOTE: All body alignment measurements should be made without trim and from metal to metal.

1. To check the body alignment, take two opposite diagonal measurements between the front, center or rear pillars. Take the measurements between reference points, such as crease lines or weld joints which are diagonally opposite each other on the two pillars being measured.

Underbody Misalignment Check

1. The dimensions of the underbody must be restored to provide the correct front and rear wheel alignment geometry.

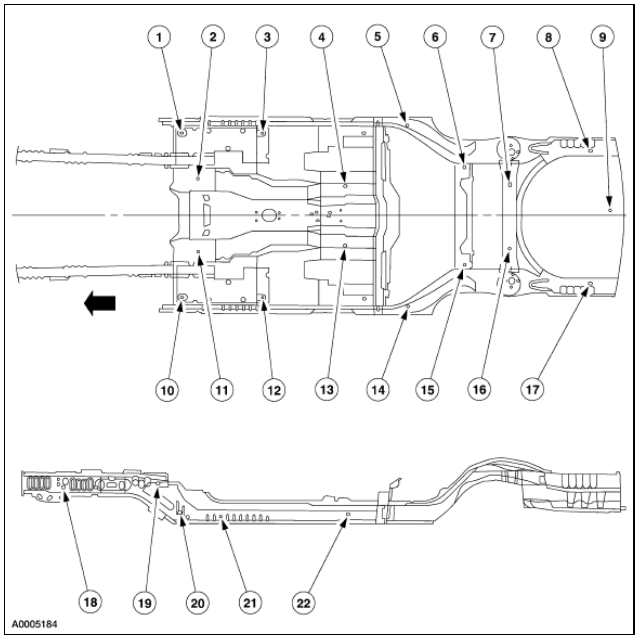
2. All the dimensions are measured between the centers of the existing holes in the underbody unless otherwise specified.

3. Inspect all underbody structural members for cracks, twists or bends. Check all welded connections for cracks. Inspect the support brackets for looseness. Carry out any necessary repairs or install new components as necessary.

4. The X axis is referenced from the front of the vehicle. The Y axis is referenced from the center line of the vehicle.

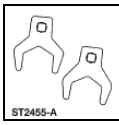
   Underbody Dimensions

Dimension	X axis mm(in)	Y axis mm(in)
1	2,044.59 mm (80.49 in)	614 mm (24.17 in)
2	2,164 mm (85.19 in)	273 mm (10.74 in)
3	2,643 mm (104.05 in)	614 mm (24.17 in)
4	3,258 mm (128.26 in)	224 mm (8.81 in)
5	3,275 mm (146.65 in)	675 mm (26.57 in)
6	4,150 mm (163.38 in)	365 mm (14.37 in)
7	4,490 mm (176.77 in)	240 mm (9.44 in)
8	5,100 mm (200.78 in)	500 mm (19.68)
9	5,250 mm (206.69 in)	50 mm (1.96)
10	2,044.59 mm (80.49 in)	614 mm (24.17 in)
11	2,164 mm (85.19 in)	273 mm (10.74 in)
12	2,643 mm (104.05 in)	614 mm (24.17 in)
13	3,258 mm (128.26 in)	224 mm (8.81 in)
14	3,725 mm (146.65 in)	675 mm (26.57 in)
15	4,150 mm (163.38 in)	365 mm (14.37 in)
16	4,490 mm (176.77 in)	240 mm (9.44 in)
17	5,100 mm (200.78 in)	500 mm (19.68 in)
18	1,118 mm (44.01 in)	
19	1,825 mm (71.85 in)	
20	1,990 mm (78.34 in)	
21	2,300 mm (90.55 in)	
22	3,258 mm (128.26 in)	


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Subframe Rear

Special Tool(s)

 ST2455-A	Torque Wrench, Driveshaft Coupler 205-474

Removal

NOTE: If a new rear subframe is to be installed, the differential and halfshafts must be removed prior to removal of the rear subframe. For all other procedures, the differential, halfshafts and rear subframe are to be removed as an assembly.

All

1. Drain the fuel tank. For additional information, refer to Section 310-00 .

2. Remove the rear wheel and tire assemblies. For additional information, refer to Section 204-04 .

Installing a new rear subframe only

3. Remove the differential and halfshafts. Refer to Section 205-02 .

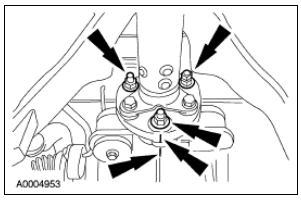
Removing rear subframe assembly (differential and halfshafts attached)

4. Remove the muffler and rear heat shield. For additional information, refer to Section 309-00 .

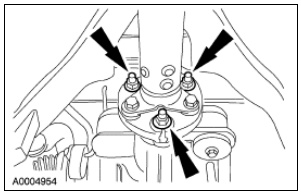
5. ⚠ **CAUTION: The differential companion flange bolts, nuts and washers must be removed as matched pairs and installed in the original location. The system balance add-on nuts must be installed in the original location.**

   NOTE: Make sure to disconnect the flexible coupling only from the differential companion flange.

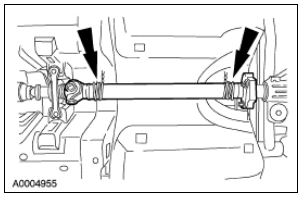
   Using different color paint markers, place index matchmarks on the differential companion flange, driveshaft flexible coupling and the differential companion flange bolts, nuts, washers and system balance add-on nuts so the driveshaft and differential may be realigned during installation.


A0004953

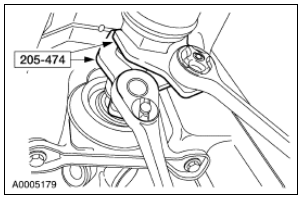
6. Remove the flex coupling bolts, nuts and washers.
   - If equipped, remove the balance nuts prior to the removal of the flex coupling nuts.



7. Support the driveshaft at the center and rear.



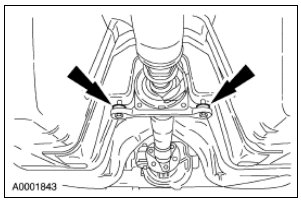
8. Using the special tools, loosen the driveshaft yoke adjuster nut.



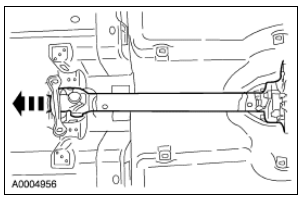
9. **NOTE:** There are shims between the center bearing mounting bracket and the body.

   NOTE: The shims must be installed in the original location.

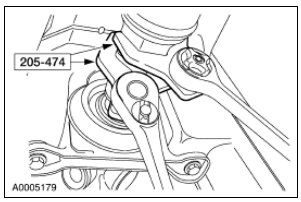
   Remove the center bearing bracket bolts and the shims.



10. Slide the rear driveshaft to the full forward position.

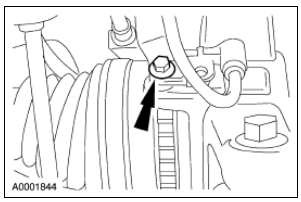


11. Using the special tools, tighten the driveshaft yoke adjuster nut.

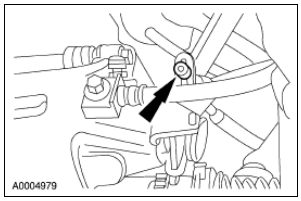


All

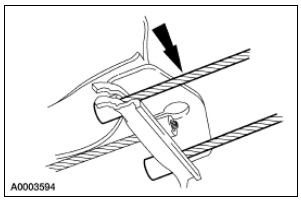
12. Remove the two bolts and position the rear anti-lock brake sensors aside.



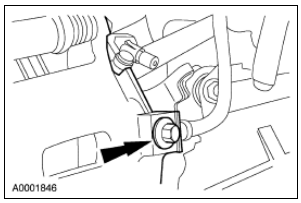
13. Disconnect the two rear parking brake cables.



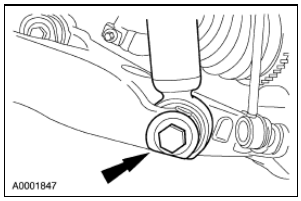
14. Disconnect the two parking brake cables from the junction bracket located to the rear of the fuel tank.



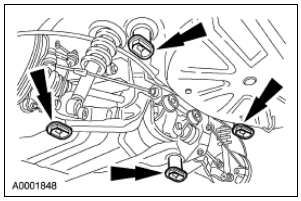
15. Remove the two bolts and position the rear brake hoses aside.



16. Remove and discard the two lower rear shock mount bolts.

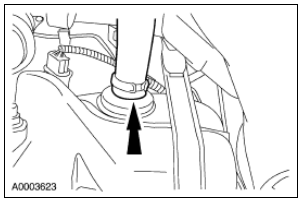


17. Paint or mark the position of the subframe to the body for assembly reference.

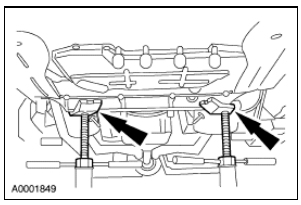


18. ⚠ **CAUTION: Make sure to remove any residual fuel from the fuel filler hose prior to removal to avoid potential spillage.**

    Loosen the clamp and remove the fuel filler hose from the fuel tank.

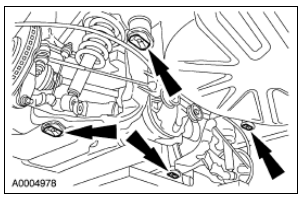


19. Support the vehicle with jack stands at the engine crossmember.



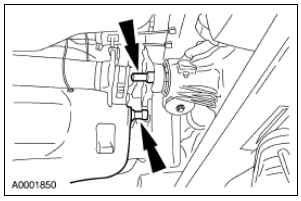
20. ⚠ **WARNING: Make sure the rear subframe is secured to the lift table. Failure to follow these instructions may result in personal injury.**

    Position the lift table under the rear subframe and remove the rear subframe bolts.



21. **NOTE:** Make sure to clear the fuel filler tube and the differential pinion stem during the subframe removal.

    Lower the rear subframe.

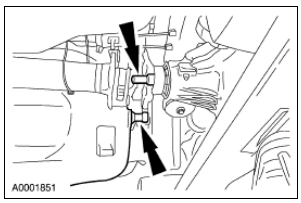


Installation

All

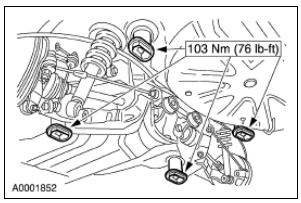
1. **NOTE:** Make sure the subframe clears the fuel filler tube and that the differential pinion stem aligns with the driveshaft.

   Raise the subframe into contact with the body and hand-start the rear subframe bolts.



2. Align the location marks.

3. Tighten the rear subframe bolts.

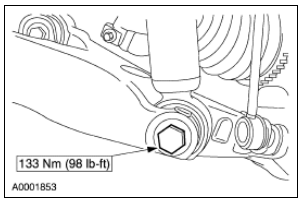


Installing a new rear subframe only

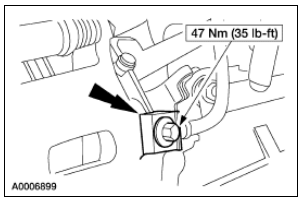
4. Install the differential and halfshafts. Refer to Section 205-02 .

All

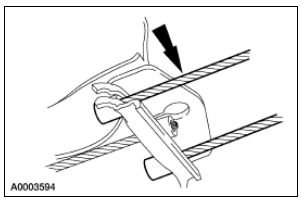
5. Install the two new lower rear shock mount bolts.



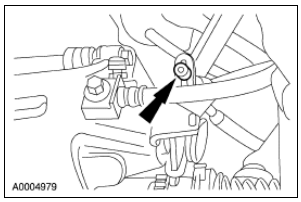
6. Position the two rear brake hoses and install the bolts.



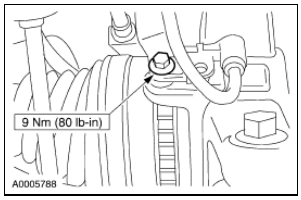
7. Connect the two parking brake cables to the junction bracket located to the rear of the fuel tank.



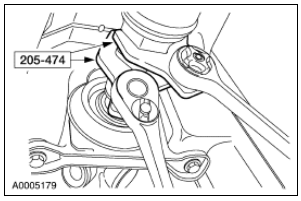
8. Connect the two rear parking brake cables.



9. Position the two rear anti-lock brake sensors and install the bolts.

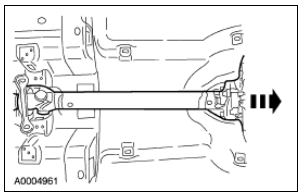


10. Using the special tools, loosen the driveshaft yoke adjuster nut.



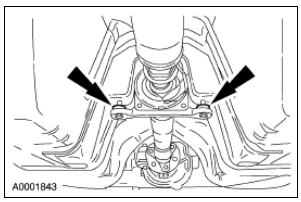
11. **NOTE:** Install one gram (0.04 ounce) of Premium Long Life Grease, XG-1-K or equivalent meeting Ford specification ESA-M1C75-B, in the alignment bushing prior to installation.

    Slide the driveshaft rearward until the flexible coupling engages with the differential companion flange.



12. **NOTE:** Make sure to install the shims between the center bearing bracket and the floor pan.

    Install the shims in their original position and loosely install the center bearing bracket bolts.

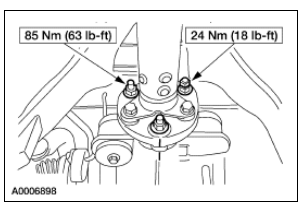


13. **NOTE:** Align the driveshaft index matchmarks.

    NOTE: Make sure to match the bolts, washers, attaching nuts and balance nuts (if equipped) to their original locations.

    Install the flex coupling bolts, attaching nuts and washers.

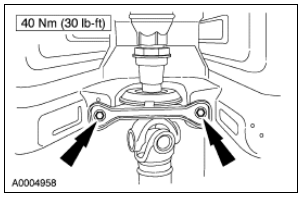
    - If equipped, install the balance nut(s).



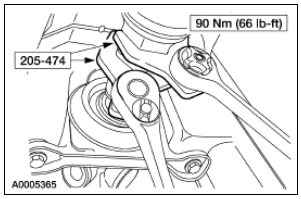
14. **NOTE:** Tighten the bolts using hand tools only.

NOTE: Avoid twisting the center bearing bracket when tightening.

Tighten the center bearing bracket bolts evenly.

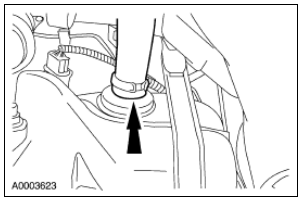


15. Using the special tools, tighten the driveshaft yoke adjuster nut.



16. Install the rear heat shield and muffler exhaust system. For additional information, refer to Section 309-00 .

17. Install the fuel filler hose and tighten the clamp.



18. Install the rear wheel and tire assemblies. For additional information, refer to Section 204-04 .

19. Bleed the brake system. For additional information, refer to Section 206-00 .

20. Refill the fuel tank.

21. Check and adjust rear alignment. For additional information, refer to Section 204-00 .

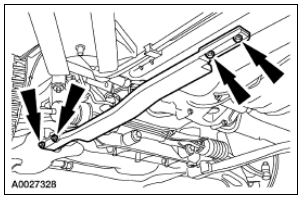
22. Test drive the vehicle. If any vibration is present, refer to Section 100-04 .

Crossmember Front

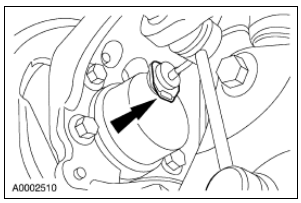
Removal

All vehicles

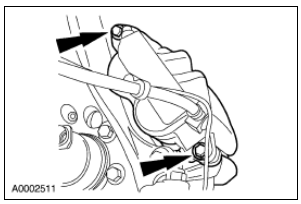
1. Remove the upper radiator sight shield.
2. Support the radiator to the upper radiator support.
3. Install the three-bar engine support.
4. Remove the front wheel and tire assemblies. For additional information, refer to Section 204-04 .
5. Remove the eight bolts and the two front I-braces.
   - Discard the bolts.



6. Remove the two clips and position the front anti-lock brake sensors aside.

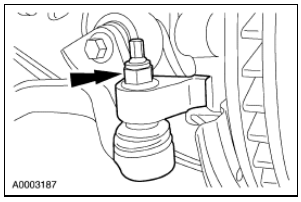


7. Remove the four bolts, support and position the front brake calipers aside.



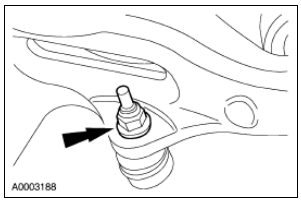
8. ⚠ **CAUTION: Hold the external hex of the tie rods when removing the nuts.**

   Remove and discard the two nuts and separate the tie rod ends from the front spindles.



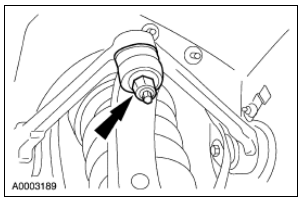
9. ⚠ **CAUTION: Hold the external hex of the stabilizer bar links when removing the nuts.**

   Remove and discard the two nuts and separate the stabilizer bar links from the lower control arm and position aside.



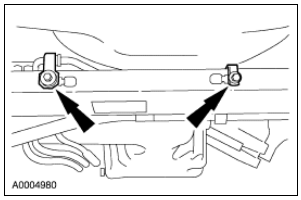
10. ⚠ **CAUTION: Hold the external hex of the ball joints when removing the nuts.**

    Remove and discard the nuts and separate the upper ball joint from the spindle.



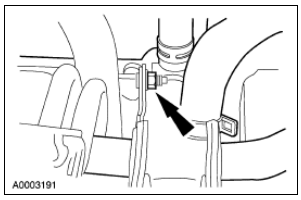
11. Remove the underbody splash shields.

12. Remove the A/C and power steering line bracket bolts.



13. **NOTE:** The nut is most easily accessed from above the front of the radiator support crossmember.

    Loosen the nut two turns, remove the bolt and position the water control valve aside.

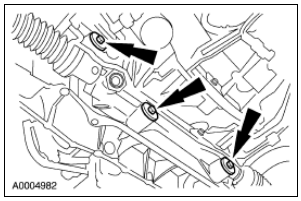


3.9L only

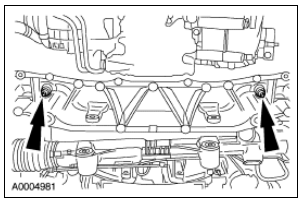
14. Remove the block heater harness retainer.

All vehicles

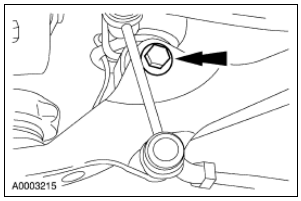
15. Remove the bolts, position and support the power steering gear aside.
    - Discard the nuts.



16. Remove the engine mount nuts.



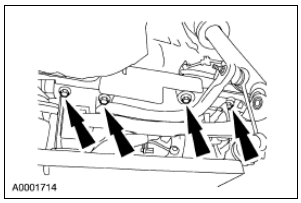
17. Remove and discard the lower front strut mount bolts.



18. ⚠ **WARNING: Make sure the front crossmembers are secured to the lift table. Failure to follow these instructions may result in personal injury.**

    NOTE: Mark the right and left crossmember locations to the body.

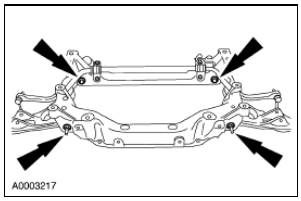
    Position the lifting table under the two crossmembers and remove the four engine crossmember bolts and the four radiator support crossmember bolts.



19. Lower the radiator support and engine crossmembers as an assembly.

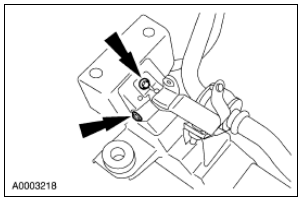
20. **NOTE:** Discard the control arm nuts and bolts.

    Remove the control arm nuts and bolts.

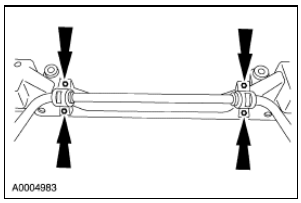


Radiator support crossmember removal

21. Remove the bolts and the water control valve bracket.



22. Remove and discard the bolts and position the stabilizer bar aside.

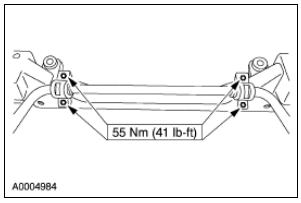


Installation

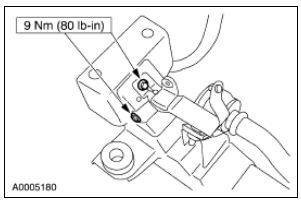
Radiator support crossmember

1. **NOTE:** The front I-brace shoulder bolt will have 1.5mm (0.059in) of clearance between the front I-brace bracket and the bolt. This is normal and the bolt should not be tightened any further.

   Position the stabilizer bar and install the new bolts.

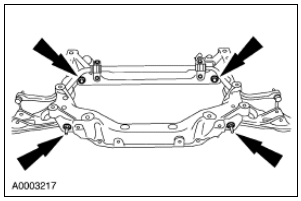


2. Position the water control valve bracket and install the bolts.



All vehicles

3. Loosely install the new control arm cam bolts and nuts.

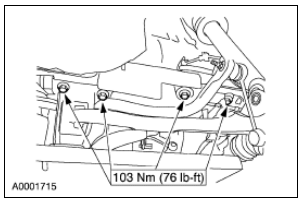


4. Position the radiator support and engine crossmembers as an assembly.

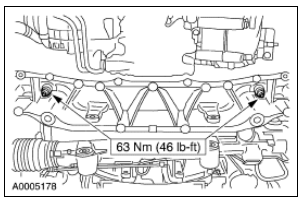
5. **NOTE:** Align the crossmember markings.

NOTE: Make sure the weight of the engine is not contacting the crossmember and make sure the crossmember assembly is in contact with the body before tightening the bolts.

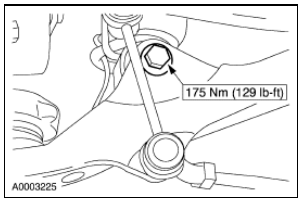
Install the four engine crossmember bolts and the four radiator support crossmember bolts.



6. Install the engine mount nuts.

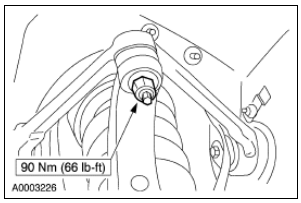


7. Install the new lower front strut mount bolts.



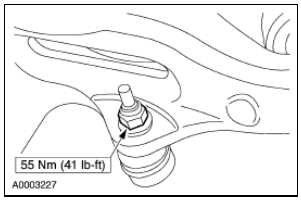
8. ⚠ **CAUTION: Hold the external hex of the ball joints when installing the nuts.**

Position the upper ball joints into the spindles and install the new nuts.

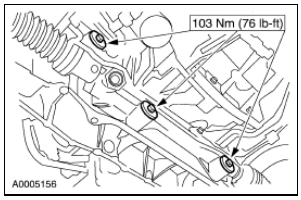


9. ⚠ **CAUTION: Hold the external hex of the stabilizer bar links when installing the nuts.**

Position the two stabilizer bar links into the lower control arm and install the new nuts.

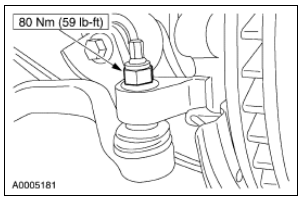


10. Position the power steering gear and install the bolts.

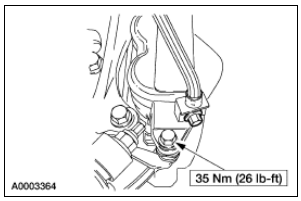


11. ⚠ **CAUTION: Hold the external hex of the tie rods when installing the nuts.**

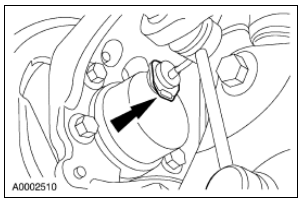
    Position the two tie rod ends into the spindles and install the new nuts.



12. Position the two front brake calipers and install the bolts.



13. Position the two front anti-lock brake sensors and install the clips.

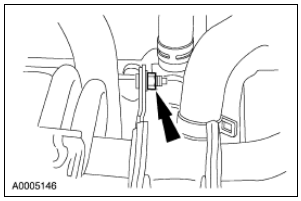


3.9L only

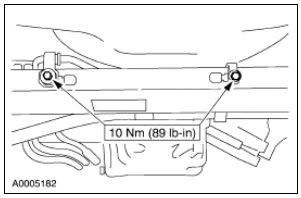
14. Install the block heater harness.

All vehicles

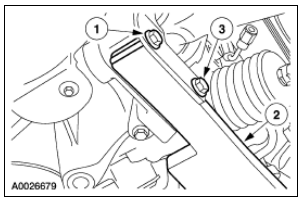
15. Position the water control valve and tighten the nut.



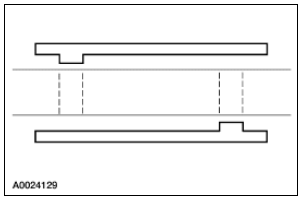
16. Position the A/C and power steering brackets and install the bolts.



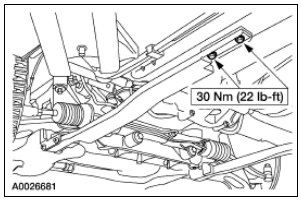
17. Position the two front I-braces and loosely install the four bolts.
    1. Loosely install the front bolts.
    2. Position the I-braces.
    3. Loosely install the rear bolts.



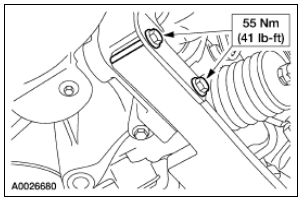
18. Make sure that the four front I-brace insulators are correctly positioned.



19. Install the four front I-brace bolts.



20. Tighten the four front I-brace bolts.



21. Install the underbody splash shields.

22. Install the front wheel and tire assemblies. For additional information, refer to Section 204-04 .

23. Remove the three-bar engine support.

24. Remove the support from the radiator.

25. Install the upper radiator sight shield.

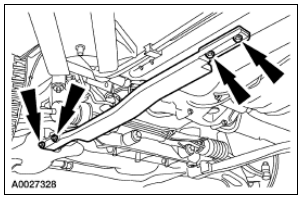
26. Align the front suspension. For additional information, refer to Section 204-00 .

Crossmember Front I-Brace Bracket

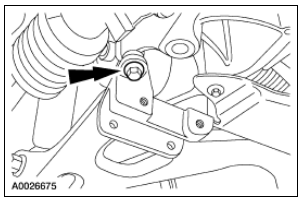
Removal

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

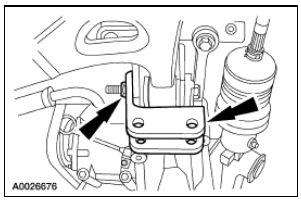
2. Remove the four bolts and the front I-brace. Discard the bolts.



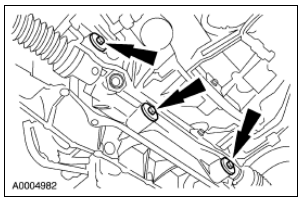
3. Remove and discard the front I-brace bracket shoulder bolt.



4. Remove the rear lower control arm nut and the front I-brace bracket. Discard the nut.



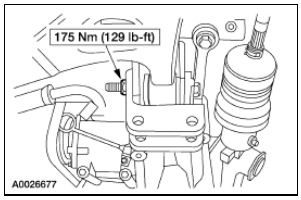
5. Remove the bolts and position the power steering gear aside.
   - Discard the nuts.



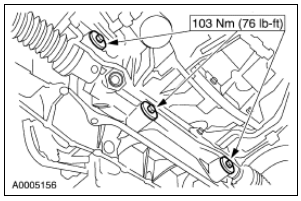
6. Remove and discard the rear lower control arm bolt.

Installation

1. Position the front I-brace bracket and install the rear lower control arm cam bolt and nut.

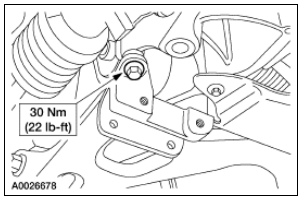


2. Position the power steering gear and install the bolts.

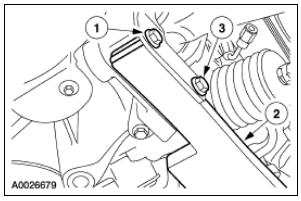


3. **NOTE:** The front I-brace shoulder bolt will have 1.5mm (0.059in) if clearance between the front I-brace bracket and the bolt. This is normal and the bolt should not be tightened any further.

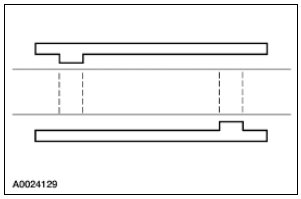
   Install the front I-brace bracket shoulder bolt.



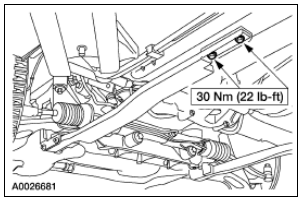
4. Position the front I-brace and loosely install the bolts.
   1. Loosely install the front bolt.
   2. Position the front I-brace.
   3. Loosely install the rear bolt.



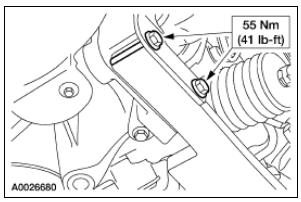
5. Make sure that the front I-brace insulators are correctly positioned.



6. Install the front I-brace bolts.



7. Tighten the front I-brace bolts.



8. Align the front suspension. For additional information, refer to Section 204-00 .

General Specifications

Item	Specification
Lubricants and Sealants	
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP	WSS-M2C153-H
Diesel engine oil	Refer to owner literature
Gasoline Engine Oil Dye 164-R3705	ESE-M99C103-B1
Threadlock® 262 E2FZ-19554-B	WSK-M2G351-A6

Engine

NOTE: This section contains information, steps and procedures that may not be specific to your engine.

This section covers general procedures and diagnosis and testing of the engine system, except for exhaust emission control devices, which are covered in the Powertrain Control/Emissions Diagnosis Manual.

The engine incorporates the following features:

- a closed positive crankcase ventilation (PCV) system. For additional information, refer to Section 303-08 .
- an exhaust emission control system. For additional information, refer to Section 303-08 .
- an evaporative emission control system. For additional information, refer to Section 303-13 .

Some engines incorporate a fail-safe cooling system. Refer to the appropriate section in Group 303 for the procedure.

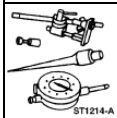
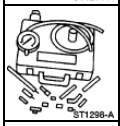
The engine, fuel system, ignition system, emissions system and exhaust system all affect exhaust emission levels and must be maintained according to the maintenance schedule. Refer to the scheduled Maintenance Guide.

Correct engine identification is required to order parts. Refer to the appropriate section in Group 303 for the procedure.

For complete vehicle and engine identification codes, refer to Section 100-01 .

Engine

Special Tool(s)

 ST1299-A	Quick Disconnect Compression Tester 134-R0212 or equivalent
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST1298-A	Engine Cylinder Leak Detection/Air Pressurization Kit 014-00708 or equivalent
 ST1296-A	Oil Pressure Gauge 303-088 (T73L-6600-A)
 ST1300-A	12 Volt Master UV Diagnostic Inspection Kit 164-R0756 or equivalent (Leak Detector)
 ST1297-A	Vacuum/Pressure Tester 164-R0253 or equivalent

Inspection and Verification

1. Verify the customer concern by operating the engine to duplicate the condition.
2. Visually inspect for obvious signs of mechanical damage. Refer to the following chart.

   Visual Inspection Chart

Mechanical
• Engine coolant leaks • Engine oil leaks • Fuel leaks • Damaged or severely worn parts • Loose mounting bolts, studs and nuts

3. If the inspection reveals obvious concerns that can be readily identified, repair as necessary.
4. If the concerns remain after the inspection, determine the symptoms. GO to Symptom Chart .

Symptom Chart

Symptom Chart

Component Tests

Engine Oil Leaks

NOTE: When diagnosing engine oil leaks, the source and location of the leak must be positively identified prior to repair.

Prior to carrying out this procedure, clean the cylinder block, cylinder heads, valve covers, oil pan and flywheel with a suitable solvent to remove all traces of oil.

Engine Oil Leaks Fluorescent Oil Additive Method

Use the 12 Volt Master UV Diagnostic Inspection Kit to carry out the following procedure for oil leak diagnosis.

1. Clean the engine with a suitable solvent to remove all traces of oil.

2. Add Gasoline Engine Oil Dye 164-R3705 meeting Ford specification ESE-M99C103-B1 or equivalent to the engine oil. Use a minimum 14.8 ml (0.5 ounce) to a maximum 29.6 ml (1 ounce) of fluorescent additive to all engines.

3. Run the engine for 15 minutes. Stop the engine and inspect all seal and gasket areas for leaks using the 12 Volt Master UV Diagnostic Inspection Kit. A clear bright yellow or orange area will identify the leak. For extremely small leaks, several hours may be necessary for the leak to appear.

Leakage Points Underhood

Examine the following areas for oil leakage:

- valve cover gaskets
- cylinder head gaskets
- oil cooler, if equipped
- oil filter adapter
- engine front cover
- oil filter adapter and filter body
- oil level indicator tube connection
- oil pressure sensor

Leakage Points Under Engine With Vehicle on Hoist

- oil pan gaskets (6710)
- oil pan sealer
- sump sealer 8 cyl.
- engine front cover gasket
- crankshaft front seal (6700)
- crankshaft rear oil seal (6701)
- crankshaft main bearing cap side bolts
- oil filter adapter and filter body
- oil cooler, if equipped

Leakage Points With Transmission and Flywheel Removed

- crankshaft rear oil seal
- rear main bearing cap parting line
- rear main bearing cap and seals
- flywheel mounting bolt holes (with flywheel (6375) installed)
- camshaft rear bearing covers (6266) or pipe plugs at the end of oil passages

Oil leaks at crimped seams in sheet metal parts and cracks in cast or stamped parts can be detected when using the dye method.

Compression Test Compression Gauge Check

1. Make sure the oil in the crankcase is of the correct viscosity and at the correct level and that the battery (10655) is correctly charged. Operate the vehicle until the engine is at normal operating temperature. Turn the ignition switch to the OFF position, then remove all the spark plugs (12405).

2. Set the throttle plates in the wide-open position.

3. Install a compression gauge such as the Compression Tester in the No. 1 cylinder.

4. Install an auxiliary starter switch in the starting circuit. With the ignition switch in the OFF position, and using the auxiliary starter switch, crank the engine a minimum of five compression strokes and record the highest reading. Note the approximate number of compression strokes necessary to obtain the highest reading.

5. Repeat the test on each cylinder, cranking the engine approximately the same number of compression strokes.

Compression Test Test Results

The indicated compression pressures are considered within specification if the lowest reading cylinder is at least 75 percent of the highest reading. For additional information, refer to the Compression Pressure Limit Chart.

Compression Pressure Limit Chart

Maximum Pressure	Minimum Pressure	Maximum Pressure	Minimum Pressure	Maximum Pressure	Minimum Pressure	Maximum Pressure	Minimum Pressure
924 kPa (134 psi)	696 kPa (101 psi)	1131 kPa (164 psi)	848 kPa (123 psi)	1338 kPa (194 psi)	1000 kPa (146 psi)	1544 kPa (224 psi)	1158 kPa (168 psi)
938 kPa (136 psi)	703 kPa (102 psi)	1145 kPa (166 psi)	855 kPa (124 psi)	1351 kPa (196 psi)	1014 kPa (147 psi)	1558 kPa (226 psi)	1165 kPa (169 psi)
952 kPa (138 psi)	717 kPa (104 psi)	1158 kPa (168 psi)	869 kPa (126 psi)	1365 kPa (198 psi)	1020 kPa (148 psi)	1572 kPa (228 psi)	1179 kPa (171 psi)
965 kPa (140 psi)	724 kPa (106 psi)	1172 kPa (170 psi)	876 kPa (127 psi)	1379 kPa (200 psi)	1034 kPa (150 psi)	1586 kPa (230 psi)	1186 kPa (172 psi)
979 kPa (142 psi)	738 kPa (107 psi)	1186 kPa (172 psi)	889 kPa (129 psi)	1303 kPa (202 psi)	1041 kPa (151 psi)	1600 kPa (232 psi)	1200 kPa (174 psi)

933 kPa (144 psi)	745 kPa (109 psi)	1200 kPa (174 psi)	903 kPa (131 psi)	1407 kPa (204 psi)	1055 kPa (153 psi)	1055 kPa (153 psi)	1207 kPa (175 psi)
1007 kPa (146 psi)	758 kPa (110 psi)	1214 kPa (176 psi)	910 kPa (132 psi)	1420 kPa (206 psi)	1062 kPa (154 psi)	1627 kPa (154 psi)	1220 kPa (177 psi)
1020 kPa (148 psi)	765 kPa (111 psi)	1227 kPa (178 psi)	917 kPa (133 psi)	1434 kPa (208 psi)	1075 kPa (156 psi)	1641 kPa (238 psi)	1227 kPa (178 psi)
1034 kPa (150 psi)	779 kPa (113 psi)	1241 kPa (180 psi)	931 kPa (135 psi)	1448 kPa (210 psi)	1083 kPa (157 psi)	1655 kPa (240 psi)	1241 kPa (180 psi)
1048 kPa (152 psi)	786 kPa (114 psi)	1255 kPa (182 psi)	936 kPa (136 psi)	1462 kPa (212 psi)	1089 kPa (158 psi)	1669 kPa (242 psi)	1248 kPa (181 psi)
1062 kPa (154 psi)	793 kPa (115 psi)	1269 kPa (184 psi)	952 kPa (138 psi)	1476 kPa (214 psi)	1103 kPa (160 psi)	1682 kPa (244 psi)	1262 kPa (183 psi)
1076 kPa (156 psi)	807 kPa (117 psi)	1282 kPa (186 psi)	965 kPa (140 psi)	1489 kPa (216 psi)	1117 kPa (162 psi)	1696 kPa (246 psi)	1269 kPa (184 psi)
1089 kPa (158 psi)	814 kPa (118 psi)	1296 kPa (188 psi)	972 kPa (141 psi)	1503 kPa (218 psi)	1124 kPa (163 psi)	1710 kPa (248 psi)	1202 kPa (186 psi)
1103 kPa (160 psi)	827 kPa (120 psi)	1310 kPa (190 psi)	979 kPa (142 psi)	1517 kPa (220 psi)	1138 kPa (165 psi)	1724 kPa (250 psi)	1289 kPa (187 psi)
1110 kPa (161 psi)	834 kPa (121 psi)	1324 kPa (192 psi)	993 kPa (144 psi)	1631 kPa (222 psi)	1145 kPa (166 psi)		

If one or more cylinders reads low, squirt approximately one tablespoon of engine oil meeting Ford specification on top of the pistons in the low-reading cylinders. Repeat the compression pressure check on these cylinders.

Compression Test Interpreting Compression Readings

1. If compression improves considerably, piston rings are worn or damaged.

2. If compression does not improve, valves are sticking or not seating correctly.

3. If two adjacent cylinders indicate low compression pressures and squirting oil on each piston does not increase compression, the head gasket may be leaking between cylinders. Engine oil or coolant in cylinders could result from this condition.
   Use the Compression Pressure Limit Chart when checking cylinder compression so that the lowest reading is within 75 percent of the highest reading.

Cylinder Leakage Detection

When a cylinder produces a low reading, use of the Engine Cylinder Leak Detection/Air Pressurization Kit will be helpful in pinpointing the exact cause.

The leakage detector is inserted in the spark plug hole, the piston is brought up to dead center on the compression stroke, and compressed air is admitted.

Once the combustion chamber is pressurized, a special gauge included in the kit will read the percentage of leakage. Leakage exceeding 20 percent is excessive.

While the air pressure is retained in the cylinder, listen for the hiss of escaping air. A leak at the intake valve (6507) will be heard in the throttle body (9E926). A leak at the exhaust valve (6505) can be heard at the

tailpipe. Leakage past the piston rings will be audible at the positive crankcase ventilation (PCV) connection. If air is passing through a blown head gasket to an adjacent cylinder, the noise will be evident at the spark plug hole of the cylinder into which the air is leaking. Cracks in the cylinder block or gasket leakage into the cooling system may be detected by a stream of bubbles in the radiator (8005).

Oil Consumption Test

The following diagnostic procedure is used to determine the source of excessive internal oil consumption.

1. **NOTE:** Oil use is normally greater during the first 16,100 km (10,000 miles) of usage. As mileage increases, oil use generally decreases. Vehicles in normal usage should get at least 1,450 km per liter (900 miles per quart) after 16,100 km (10,000 miles) of service. High speed driving, towing, high ambient temperature and other factors may result in greater oil use.

   Define excessive oil consumption, such as the number of miles driven per liter (quart) of oil used. Also determine customer's driving habits, such as sustained high speed operation, towing, extended idle and other considerations.

2. Verify that the engine has no external oil leak as described under Engine Oil Leaks in the Diagnosis and Testing portion of this section.

3. Verify that the engine has the correct oil level dipstick (6750).

4. Verify that the engine is not being run in an overfilled condition. Check the oil level at least five minutes after a hot shutdown with the vehicle parked on a level surface. In no case should the level be above MAX or the letter F in FULL. If significantly overfilled, carry out Steps 6a through 6d.

5. Verify the spark plugs are not oil saturated. If the spark plugs are oil saturated and compression is good it can be assumed the valve seals or valve guides are at fault.

6. Carry out an oil consumption test:

a. Drain the engine oil, remove the oil filter (6714) and refill with one liter (quart) less than the recommended amount.
b. Run the engine for three minutes (10 minutes if cold), and allow the oil to drain back for at least five minutes with the vehicle on a level surface.
c. Remove oil level dipstick and wipe clean. (Do not wipe with anything contaminated with silicone compounds.) Reinstall the oil level dipstick, being sure to seat it firmly in the oil level indicator tube (6754). Remove the oil level dipstick and draw a mark on the back (unmarked) surface at the indicated oil level. This level should be about the same as the MIN or ADD mark on the face of the oil level dipstick.
d. Add one liter (quart) of oil. Restart the engine and allow to idle for at least two minutes. Shut off the engine and allow the oil to drain back for at least five minutes. Mark the oil level dipstick, using the procedure above.
e. Record the vehicle mileage.
f. Instruct the customer to drive the vehicle as usual and carry out the following:
   - Check the oil level regularly at intervals of 160 to 240 km (100-150 miles).
   - Return to the repair point when the oil level drops below the lower (MIN or ADD) mark on the oil level dipstick.
   - Add only full liters (quarts) of the same oil in an emergency. Note the mileage at which the oil is added.
g. Check the oil level under the same conditions and at the same location as in Steps 5c and 5d.
   - Measure the distance from the oil level to the UPPER mark on the oil level dipstick and

record.
- Measure the distance between the two scribe marks and record.
- Divide the first measurement by the second.
- Divide the distance driven during the oil test by the result. This quantity is the approximate oil consumption rate in kilometers per liter or in miles per quart.

h. If the oil consumption rate is unacceptable, go to Step 7.

7. Check the positive crankcase ventilation (PCV) system. Make sure the system is not plugged.

8. Check for plugged oil drain-back holes in the cylinder heads and cylinder block.

9. If the condition still exists after carrying out the above steps, go to Step 10.

10. Carry out a cylinder compression test or cylinder leak detection test with Engine Cylinder Leak Detection/Air Pressurization Kit. This can help determine the source of oil consumption such as valves, piston rings or other areas.

11. **NOTE:** After determining if new parts should be installed, make sure correct new parts are used.

    Check valve guides for excessive guide clearance. Install new valve stem seals (6571) after verifying valve guide clearance.

12. Worn or damaged internal engine components can cause excessive oil consumption. Small deposits of oil on the tips of spark plugs can be a clue to internal oil consumption. If internal oil consumption still persists, proceed as follows:

    a. Remove the engine from the vehicle and place it on an engine work stand. Remove the intake manifolds (9424), cylinder heads, oil pan (6675) and oil pump (6600).
    b. Check piston ring clearance, ring gap and ring orientation. Repair as necessary.
    c. Check for excessive bearing clearance. Repair as necessary.

13. Repeat the oil consumption test (Step 6) to confirm the oil consumption concern has been resolved.

Intake Manifold Vacuum Test

Bring the engine to normal operating temperature. Connect the Vacuum/Pressure Tester to the intake manifold. Run the engine at the specified idle speed.

The vacuum gauge should read between 51-74 kPa (15-22 in-Hg) depending upon the engine condition and the altitude at which the test is conducted. Subtract 4.0193 kPa (1 in-Hg) from the specified reading for every 304.8 m (1,000 feet) of elevation above sea level.

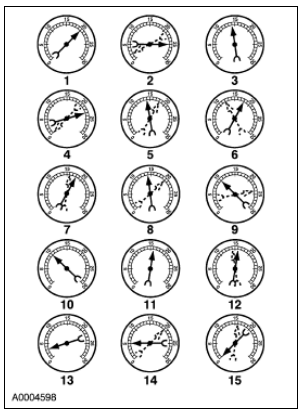
The reading should be steady. If necessary, adjust the gauge damper control (where used) if the needle is fluttering rapidly. Adjust the damper until the needle moves easily without excessive flutter.

Intake Manifold Vacuum Test Interpreting Vacuum Gauge Readings

A careful study of the vacuum gauge reading while the engine is idling will help pinpoint trouble areas. Always conduct other appropriate tests before arriving at a final diagnostic decision. Vacuum gauge readings, although helpful, must be interpreted carefully.

Most vacuum gauges have a normal band indicated on the gauge face.

The following are potential gauge readings. Some are normal; others should be investigated further.



1. NORMAL READING: Needle between 51-74 kPa (15-22 in-Hg) and holding steady.

2. NORMAL READING DURING RAPID ACCELERATION AND DECELERATION: When the engine is rapidly accelerated (dotted needle), the needle will drop to a low reading (not to zero). When the throttle is suddenly released, the needle will snap back up to a higher than normal figure.

3. NORMAL FOR HIGH-LIFT CAMSHAFT WITH LARGE OVERLAP: The needle will register as low as 51 kPa (15 in-Hg) but will be relatively steady. Some oscillation is normal.

4. WORN RINGS OR DILUTED OIL: When the engine is accelerated (dotted needle), the needle drops to 0 kPa (0 in-Hg). Upon deceleration, the needle runs slightly above 74 kPa (22 in-Hg).

5. STICKING VALVES: When the needle (dotted) remains steady at a normal vacuum but occasionally flicks (sharp, fast movement) down and back about 13 kPa (4 in-Hg), one or more valves may be sticking.

6. BURNED OR WARPED VALVES: A regular, evenly-spaced, downscale flicking of the needle indicates one or more burned or warped valves. Insufficient valve clearance will also cause this reaction.

7. POOR VALVE SEATING: A small but regular downscale flicking can mean one or more valves are not seating.

8. WORN VALVE GUIDES: When the needle oscillates over about a 13 kPa (4 in-Hg) range at idle speed, the valve guides could be worn. As engine speed increases, the needle will become steady if guides are responsible.

9. WEAK VALVE SPRINGS: When the needle oscillation becomes more violent as engine rpm is increased, weak valve springs are indicated. The reading at idle could be relatively steady.

10. LATE VALVE TIMING: A steady but low reading could be caused by late valve timing.

11. IGNITION TIMING RETARDING: Retarded ignition timing will produce a steady but somewhat low reading.

12. INSUFFICIENT SPARK PLUG GAP: When spark plugs are gapped too close, a regular, small pulsation of the needle can occur.

13. INTAKE LEAK: A low, steady reading can be caused by an intake manifold or throttle body gasket leak.

14. BLOWN HEAD GASKET: A regular drop of fair magnitude can be caused by a blown head gasket or warped cylinder head-to-cylinder block surface.

15. RESTRICTED EXHAUST SYSTEM: When the engine is first started and is idled, the reading may be normal, but as the engine rpm is increased, the back pressure caused by a clogged muffler (5230), kinked tailpipe or other concerns will cause the needle to slowly drop to 0 kPa (0 in-Hg). The needle then may slowly rise. Excessive exhaust clogging will cause the needle to drop to a low point even if the engine is only idling.

16. When vacuum leaks are indicated, search out and correct the cause. Excess air leaking into the system will upset the fuel mixture and cause concerns such as rough idle, missing on acceleration or burned valves. If the leak exists in an accessory unit such as the power brake booster (2005), the unit will not function correctly. Always fix vacuum leaks.

Excessive Engine Oil Consumption

The amount of oil an engine uses will vary with the way the vehicle is driven in addition to normal engine-to-engine variation. This is especially true during the first 16,100 km (10,000 miles) when a new engine is being broken in or until certain internal engine components become conditioned. Vehicles used in heavy-duty operation may use more oil. The following are examples of heavy-duty operation:

- trailer towing applications
- severe loading applications
- sustained high speed operation

Engines need oil to lubricate the following internal components:

- cylinder block cylinder walls
- pistons and piston, pin and rings (6102)
- intake and exhaust valve stems
- intake and exhaust valve guides
- all internal engine components

When the pistons move downward, a thin film of oil is left on the cylinder walls. As the vehicle is operated, some oil is also drawn into the combustion chambers past the intake and exhaust valve stem seals and burned.

The following is a partial list of conditions that can affect oil consumption rates:

- engine duty cycle
- operator driving habits
- ambient temperature
- quality and viscosity of the oil
- oil filler cap not seated
- oil level indicator not seated

Operation under varying conditions can frequently be misleading. A vehicle that has been run for several thousand miles on short trips or in below-freezing ambient temperatures may have consumed a "normal" amount of oil. However, when checking the engine oil level, it may measure up to the FULL or MAX on the oil level dipstick due to dilution (condensation and fuel) in the engine crankcase. The vehicle might then be driven at high speeds on the highway where the condensation and fuel boil off. The next time the engine oil is checked, it may appear that a liter (quart) of oil was used in about 160 km (100 miles). This perceived 160 km (100 miles) per liter (quart) oil consumption rate causes customer concern even though the actual overall oil consumption rate is about 2400 km (1500 miles) per liter (quart).

Make sure the selected engine oil meets the current recommended API performance category with SAE viscosity grade as shown in the vehicle Owner Literature. It is also important that the engine oil is changed at the intervals specified. For additional information, refer to the Vehicle Owner Literature.

Oil Pressure Test

1. Disconnect and remove the oil pressure sensor (9278) from the engine.
2. Connect the Engine Oil Pressure Gauge to the oil pressure sender oil galley port.
3. Run the engine until normal operating temperature is reached.
4. Run the engine at the specified rpm and record the gauge reading.
5. The oil pressure should be within specifications; For additional information, refer to the specification chart in the appropriate engine section.
6. If the pressure is not within specification, check the following possible sources:
   - insufficient oil
   - oil leakage
   - worn or damaged oil pump
   - oil pump screen cover and tube (6622)
   - excessive main bearing clearance
   - excessive connecting rod bearing clearance

Valve Train Analysis Engine Off Valve Cover Removed

Check for damaged or severely worn parts and correct assembly. Make sure correct parts are used with the static engine analysis as follows.

Valve Train Analysis Engine Off

- Check for loose mounting bolts on camshaft caps.
- Check valve shim to camshaft gap.

Valve Train Analysis Engine Off, Camshaft Engines

- Check for broken or damaged parts.

Valve Train Analysis Valve Springs

- Check for broken or damaged parts.

Valve Train Analysis Engine Off, Valve Spring Retainer and Valve Spring Retainer Keys

- Check for correct seating of the valve spring retainer key (6518) on the valve stem and in valve spring retainer (6514).
- Check for correct seating on the valve stem.

Valve Train Analysis Engine Off, Valves and Cylinder Head

- Check for plugged oil drain back holes.
- Check for worn or damaged valve tips.

- Check for missing or damaged valve stem seals or guide-mounted valve stem seal.
- Check valve tappet shim gap.
- Check for missing or worn valve spring seats.
- Check for plugged oil metering orifice in cylinder head oil reservoir (if equipped).

Static checks (engine off) are to be made on the engine prior to the dynamic procedure.

Valve Train Analysis Engine Off, Camshaft Lobe Lift OHC Engines

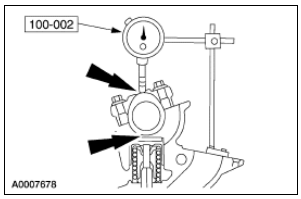
Check the lift of each camshaft lobe in consecutive order and make a note of the readings.

1. Remove the valve covers.

2. Remove the spark plugs.

3. Install the special tool so the rounded tip of indicator is on top of the camshaft lobe and on the same plane as the valve tappet.

4. Rotate the crankshaft using a breaker bar and socket attached to the crankshaft pulley retainer bolt. Rotate the crankshaft until the base circle of the camshaft lobe is reached.



5. Zero the dial indicator. Continue to rotate the crankshaft until the high-lift point of the camshaft lobe is in the fully-raised position (highest indicator reading).

6. To check the accuracy of the original indicator reading, continue to rotate crankshaft until the base circle is reached. The indicator reading should be zero. If zero reading is not obtained, repeat Steps 1 through 6.

7. Install the spark plugs.

8. Install the valve covers.

Valve Train Analysis Engine Off, Valve Tappet

Valve tappet noise can be caused by any of the following:

- excessive valve tappet shim gap
- excessive valve guide wear

Excessive collapsed valve tappet shim gap can be caused by loose rocker arm seat bolts/nuts, incorrect initial adjustment or wear of valve tappet shim face.

For additional information, refer to the valve train shim and gap inspection procedure in the appropriate engine section.

Sprockets

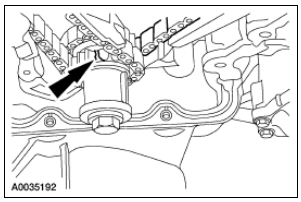
1. ⚠ **WARNING: To avoid the possibility of personal injury or damage to the vehicle, do not operate the engine with the hood open until the fan blade has been examined for possible cracks and separation. Failure to follow these instructions may result in personal injury.**

   NOTE: Specifications show the expected minimum or maximum condition.

   NOTE: If a component fails to meet the specifications, it is necessary to install a new component or refinish the component. If the component can be refinished, wear limits are provided as an aid to making a decision. If a component fails to meet specifications and cannot be refinished, a new component must be installed.

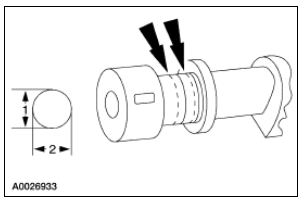
   Inspect the timing chain/belt and the sprocket.

   - Install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



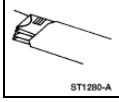
Camshaft Journal Diameter

1. Measure each camshaft journal diameter in two directions.
    - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



Camshaft Journal Clearance, Plastigage Method

Special Tool(s)

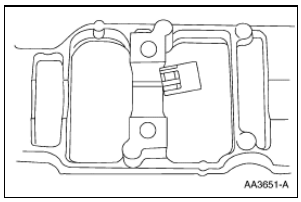
 ST1280-A	Plastigage 303-D031 (D81L-6002-B) or equivalent

NOTE: The camshaft journals must meet specifications before checking camshaft journal clearance.

1. Remove the camshaft bearing cap and lay Plastigage across the surface. Refer to the appropriate section in Group 303 for the procedure.

2. **NOTE:** Do not turn the camshaft while carrying out this procedure.

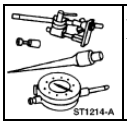
   Position the camshaft bearing cap and install the bolts. Refer to the appropriate section in Group 303 for the procedure.


AA3651-A

3. Use Plastigage to verify the camshaft journal clearance.
   - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.

Camshaft End Play OHC Engines

Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

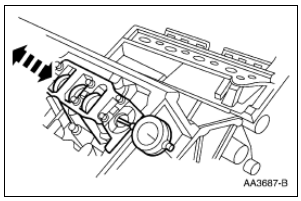
1. Remove the roller followers. Refer to the appropriate section in Group 303 for the procedure.

2. Use a Dial Indicator Gauge with Holding Fixture to measure camshaft end play.

3. Position the camshaft to the rear of the cylinder head.

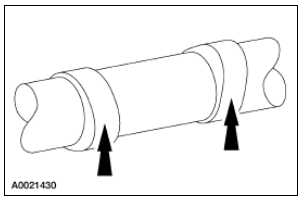
4. Zero the indicator.

5. Move the camshaft to the front of the cylinder head. Note and record the camshaft end play.
   - If camshaft end play exceeds specifications, install new camshaft and recheck end play. Refer to the appropriate section in Group 303 for the procedure.
   - If camshaft end play exceeds specification after camshaft installation, install a new cylinder head. Refer to the appropriate section in Group 303 for the procedure.


AA3687-B

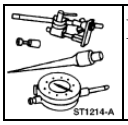
Camshaft Lobe Surface

1. Inspect camshaft lobes for pitting or damage in the contact area. Minor pitting is acceptable outside the contact area.
    - If excessive pitting or damage is present, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.

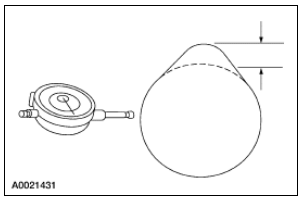


Camshaft Lobe Lift

Special Tool(s)

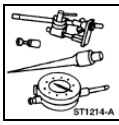
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

1. Use a Dial Indicator Gauge with Holding Fixture to measure camshaft intake/exhaust lobe lift.
   - Rotate the camshaft and subtract the lowest indicator reading from the highest indicator reading to figure the camshaft lobe lift.
   - Refer to the appropriate section in Group 303 for the procedure.



Camshaft Runout

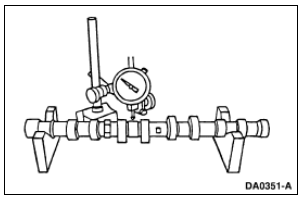
Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

1. **NOTE:** Camshaft journals must be within specifications before checking runout.

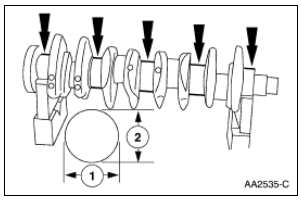
   Use a Dial Indicator Gauge with Holding Fixture to measure the camshaft runout.

   - Rotate the camshaft and subtract the lowest indicator reading from the highest indicator reading.
   - For additional information, refer to the specification chart in the appropriate engine section.
   - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



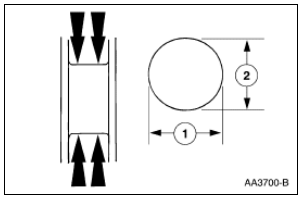
Crankshaft Main Bearing Journal Diameter

1. Measure each of the crankshaft main bearing journal diameters in at least two directions.
   - Refer to the appropriate section in Group 303 for the procedure.
   - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



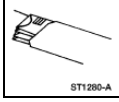
Crankshaft Main Bearing Journal Taper

1. Measure each of the crankshaft main bearing journal diameters in at least two directions at each end of the main bearing journal.
    - Refer to the appropriate section in Group 303 for the procedure.
    - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



Crankshaft Main Bearing Journal Clearance

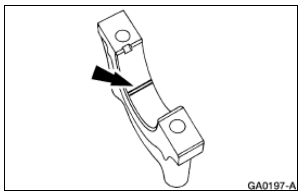
Special Tool(s)

 ST1280-A	Plastigage 303-D031 (D81L-6002-B) or equivalent

NOTE: Crankshaft main bearing journals must be within specifications before checking journal clearance.

1. Remove the crankshaft main bearing caps and crankshaft main bearing.

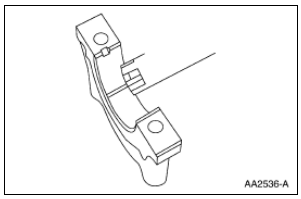
2. Lay a piece of Plastigage across the face of each crankshaft main bearing surface.


GA0197-A

3. **NOTE:** Do not turn the crankshaft while carrying out this procedure.

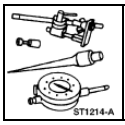
   Install and remove the crankshaft main bearing cap.

4. Verify the crankshaft journal clearance.
   - Refer to the appropriate section in Group 303 for the procedure.
   - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.


AA2536-A

Crankshaft End Play

Special Tool(s)

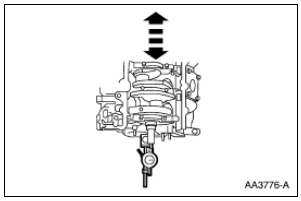
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

1. Measure the crankshaft end play. Use a Dial Indicator Gauge with Holding Fixture to measure crankshaft end play.

2. Position the crankshaft to the rear of the cylinder block.

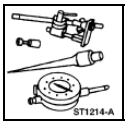
3. Zero the indicator.

4. Move the crankshaft to the front of the cylinder block. Note and record the crankshaft end play.
   - If crankshaft end play exceeds specifications, install a new crankshaft thrust washer (6334) or crankshaft thrust main bearing (6337). Refer to the appropriate section in Group 303 for the procedure.



Crankshaft Runout

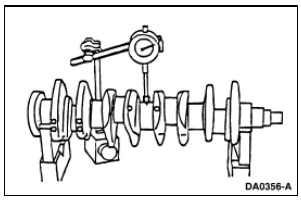
Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent

1. **NOTE:** Crankshaft main bearing journals must be within specifications before checking runout.

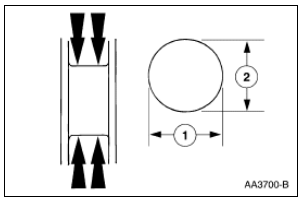
   Use the Dial Indicator Gauge with Holding Fixture to measure the crankshaft runout.

   - Refer to the appropriate section in Group 303 for the procedure.
   - Rotate the crankshaft and subtract the lowest dial indicator reading from the highest dial indicator reading to figure the crankshaft runout. If it is out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



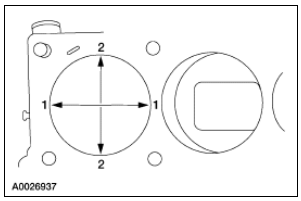
Crankshaft Connecting Rod Journal Taper, Out of Round

1. Measure the crankshaft connecting rod journal diameters in two directions perpendicular to one another at each end of the connecting rod journal. The difference in the measurements from one end to the other is the taper. Verify measurement is within the wear limit.
    - Refer to the appropriate section in Group 303 for the procedure.
    - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



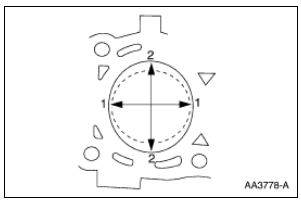
Cylinder Bore Taper

1. Measure the cylinder bore at the top, middle, and bottom of piston ring travel in two directions as indicated. Verify the cylinder bore is within the wear limit. The difference indicates the cylinder bore taper. Bore the cylinder to the next oversize.
    - Refer to the appropriate section in Group 303 for the procedure.



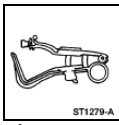
Cylinder Bore Out-of-Round

1. Measure the cylinder bore in two directions. The difference is the out-of-round. Verify the out-of-round is within the wear limit and bore the cylinder to the next oversize limit.
    - Refer to the appropriate section in Group 303 for the procedure.



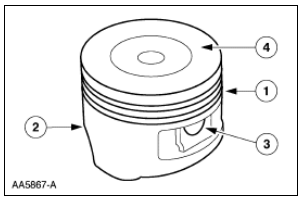
Piston Inspection

Special Tool(s)

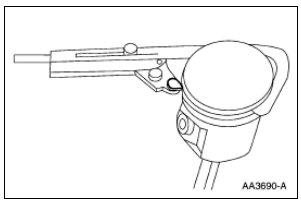
 ST1279-A	Scraper, Piston Ring Groove 303-D033 (D81L-6002-D) or equivalent

⚠ CAUTION: Do not use a caustic cleaning solution or a wire brush to clean the pistons or damage can occur.

1. Clean and inspect the (1) ring lands, (2) skirts, (3) pin bosses, and the (4) tops of the pistons. If wear marks, scores or glazing is found on the piston skirt, check for a bent or twisted connecting rod.



2. Use the Piston Ring Groove Scraper to clean the piston ring grooves.
   - Make sure the oil ring holes are clean.



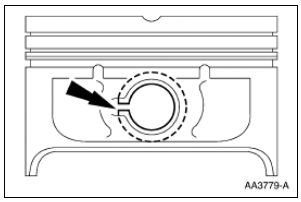
Piston Pin to Bore Diameter

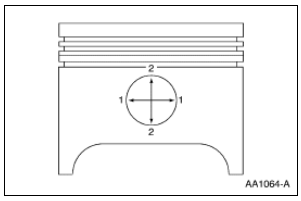
1. ⚠ **WARNING: Cover the end of the pin bore with a hand or shop rag when removing the retainer ring, since it has a tendency to spring out. Wear eye protection.**

   NOTE: Piston and piston pins are a matched set and should not be interchanged.

   Measure the piston pin bore diameter in two directions on each side. Verify the diameter is within specification.

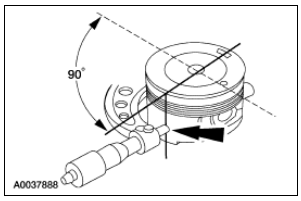
   - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.





Piston Diameter

1. Measure the piston diameter 90 degrees from the piston pin at the point indicated. Refer to the appropriate section in Group 303 for the procedure.
    - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



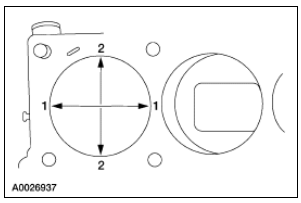
Piston to Cylinder Bore Clearance

1. Subtract the piston diameter from the cylinder bore diameter to find the piston-to-cylinder bore clearance.

Piston Selection

NOTE: The cylinder bore must be within the specifications for taper and out-of-round before fitting a piston.

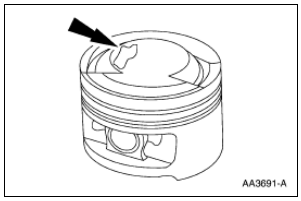
1. Select a piston size based on the cylinder bore.



2. **NOTE:** For precision fit, new pistons are divided into three categories within each size range based on their relative position within the range. A paint spot on the new pistons indicates the position within the size range.

   Choose the piston with the correct paint color.

   - Refer to the appropriate section in Group 303 for the procedure.



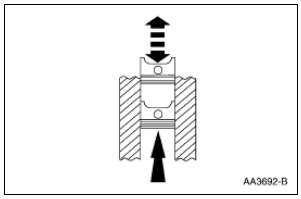
Piston Ring End Gap

⚠ CAUTION: Use care when fitting piston rings to avoid possible damage to the piston ring or the cylinder bore.

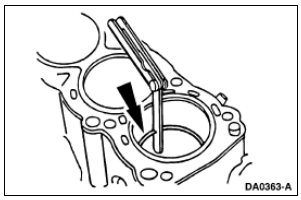
⚠ CAUTION: Piston rings should not be transferred from one piston to another.

NOTE: Cylinder bore must be within specification for taper and out-of-round.

1. Use a piston without rings to push a piston ring in a cylinder to the bottom of ring travel.

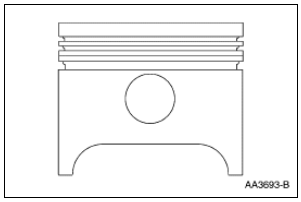


2. Use a feeler gauge to measure the top piston ring end gap and the second piston ring end gap.
   - Refer to the appropriate section in Group 303 for the procedure.

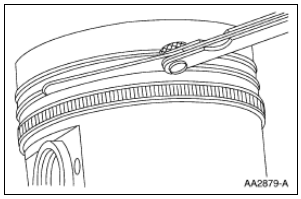


Piston Ring-to-Groove Clearance

1. Inspect the piston for ring land damage or accelerated wear.

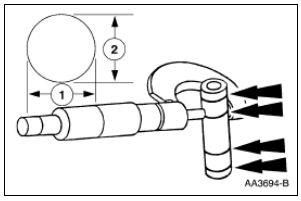


2. Measure the piston ring-to-groove clearance.
   - Refer to the appropriate section in Group 303 for the procedure.
   - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



Piston Pin Diameter

1. Measure the piston pin diameter in two directions at the points shown. Verify the diameter is within specification.
    - Refer to the appropriate section in Group 303 for the procedure.
    - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.

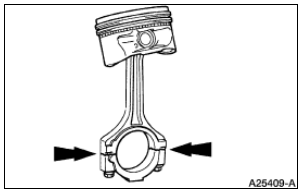


Connecting Rod Cleaning

⚠ CAUTION: Do not use a caustic cleaning solution or damage to connecting rods can occur.

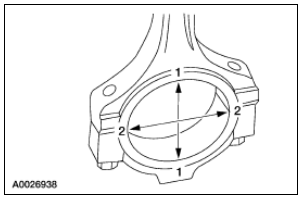
1. **NOTE:** The connecting rod large end is a matched set. The connecting rod cap must be installed on the original connecting rod in the original position. Do not reverse the cap. Parts are not interchangeable.

   Mark and separate the parts and clean with solvent. Clean the oil passages.



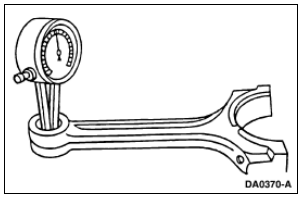
Connecting Rod Large End Bore

1. Tighten the bolts to specification, then measure the bore in two directions. The difference is the connecting rod bore out-of-round. Verify the out-of-round is within specification.
    - Refer to the appropriate section in Group 303 for the procedure.
    - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



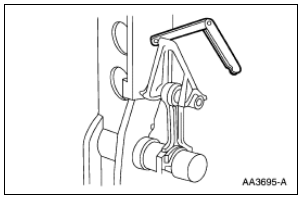
Connecting Rod Bushing Diameter

1. Measure the inner diameter of the connecting rod bushing, if equipped. Verify the diameter is within specification.
    - Refer to the appropriate section in Group 303 for the procedure.
    - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



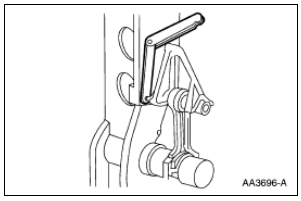
Connecting Rod Bend

1. Measure the connecting rod bend on a suitable alignment fixture. Follow the instructions of the fixture manufacturer. Verify the bend measurement is within specification.
    - Refer to the appropriate section in Group 303 for the procedure.
    - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



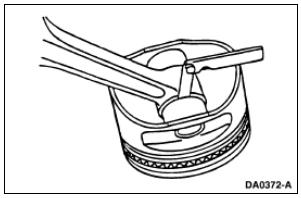
Connecting Rod Twist

1. Measure the connecting rod twist on a suitable alignment fixture. Follow the instructions of the fixture manufacturer. Verify the measurement is within specification.
    - Refer to the appropriate section in Group 303 for the procedure.
    - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



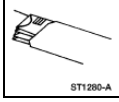
Connecting Rod Piston Pin Side Clearance

1. Measure the clearance between the connecting rod and the piston. Verify the measurement is within specification.
    - Refer to the appropriate section in Group 303 for the procedure.
    - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



Connecting Rod Bearing Journal Clearance

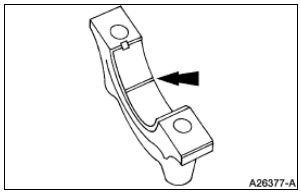
Special Tool(s)

 ST1280-A	Plastigage 303-D031 (D81L-6002-B) or equivalent

NOTE: The crankshaft connecting rod journals must be within specifications to check the connecting rod bearing journal clearance.

1. Remove the connecting rod bearing cap.

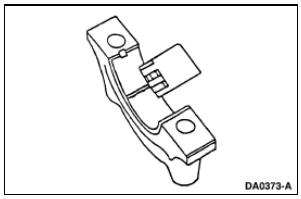
2. Position a piece of Plastigage across the bearing surface.



3. **NOTE:** Do not turn the crankshaft during this step.

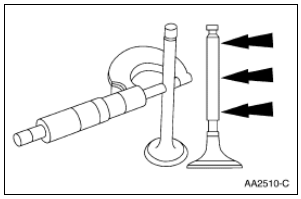
   Install and tighten to specifications, then remove the connecting rod bearing cap.

4. Measure the Plastigage to get the connecting rod bearing journal clearance. The Plastigage should be smooth and flat. A changing width indicates a tapered or damaged connecting rod or connecting rod bearing.
   - Refer to the appropriate section in Group 303 for the procedure.
   - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



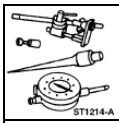
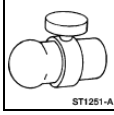
Valve Stem Diameter

1. Measure the diameter of each intake and exhaust valve stem at the points shown. Verify the diameter is within specification.
    - Refer to the appropriate section in Group 303 for the procedure.
    - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



Valve Stem to Valve Guide Clearance

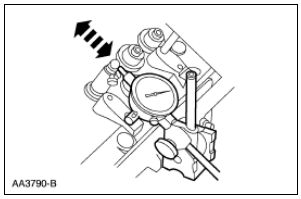
Special Tool(s)

 ST1214-A	Dial Indicator with Bracketry 100-002 (TOOL-4201-C) or equivalent
 ST1251-A	Valve Stem Checking Tool 303-004 (TOOL-6505-E) or equivalent

NOTE: Valve stem diameter must be within specifications before checking valve stem to valve guide clearance.

1. **NOTE:** If necessary, use a magnetic base.

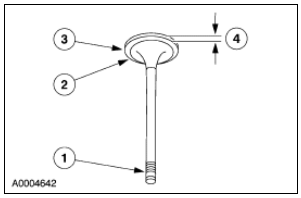
   Install a Valve Stem Clearance Tool on the valve stem and install a Dial Indicator with Bracketry. Lower the valve until the Valve Stem Clearance Tool contacts the upper surface of the valve guide.



2. Move the Valve Stem Clearance Tool toward the indicator and zero the indicator. Move the Valve Stem Clearance Tool away from the indicator and note the reading. The reading will be DOUBLE the valve stem-to-valve guide clearance. Valves with oversize stems will need to be installed if out of specification.

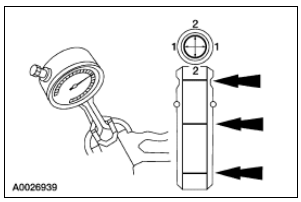
Valve Inspection

1. Inspect the following valve areas:
    1. the end of the stem for grooves or scoring
    2. the valve face and the edge for pits, grooves or scores
    3. the valve head for signs of burning, erosion, warpage and cracking
    4. the valve margin for wear



Valve Guide Inner Diameter

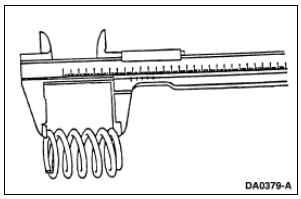
1. Measure the inner diameter of the valve guides in two directions where indicated.
   - Refer to the appropriate section in Group 303 for the procedure.



2. If the valve guide is not within specifications, ream the valve guide and install a valve with an oversize stem or remove the valve guide and install a new valve guide.

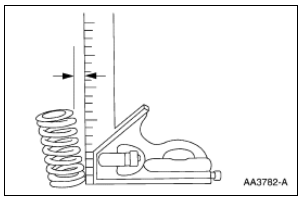
Valve Spring Free Length

1. Measure the free length of each valve spring.
    - Refer to the appropriate section in Group 303 for the procedure.
    - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.



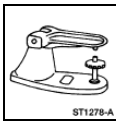
Valve Spring Squareness

1. Measure the out-of-square on each valve spring.
    - Turn the valve spring and observe the space between the top of the valve spring and the square. Install a new valve spring if out of square. Refer to the appropriate section in Group 303 for the procedure.

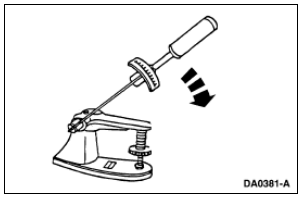


Valve Spring Strength

Special Tool(s)

 ST1278-A	Pressure Gauge, Valve/Clutch Spring 303-006 (TOOL-6513-DD) or equivalent

1. Use a Valve/Clutch Spring Pressure Gauge to check the valve spring for correct strength at the specified valve spring length.
    - Refer to the appropriate section in Group 303 for the procedure.
    - If out of specification, install new components as necessary. Refer to the appropriate section in Group 303 for the procedure.

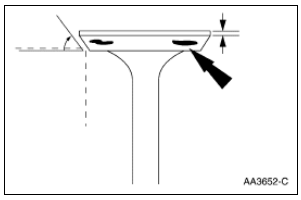


Valve Seat Inspection

Valve and Seat Refacing Measurements

⚠ CAUTION: After grinding valves or valve seats, check valve clearance.

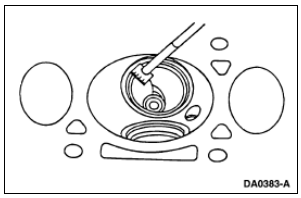
1. Check the valve head and seat.
   - Check valve angles.
   - Check margin width.
   - Refer to the appropriate section in Group 303 for the procedure.
   - Be sure margin width is within specification.



2. Inspect for abnormalities on the valve face and seat.

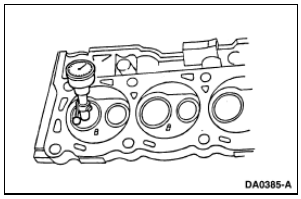
Valve Seat Width

1. Measure the valve seat width. If necessary, grind the valve seat to specification.
    - Measure the intake valve seat width.
    - Measure the exhaust valve seat width.
    - Recheck the valve spring installed length after the seats have been ground, and shim the valve springs as necessary to achieve the correct installed spring length.
    - Refer to the appropriate section in Group 303 for the procedure.



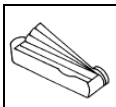
Valve Seat Runout

1. Use the Valve Seat Runout Gauge to check valve seat runout.

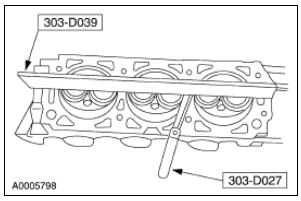


Cylinder Head Distortion

Special Tool(s)

 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent
 ST1246-A	Straight Edge 303-D039 (D83L-4201-A) or equivalent

1. Use the special tools to inspect the cylinder head for flatness. If the cylinder head is distorted, install a new cylinder head. Refer to the appropriate section in Group 303 for the procedure.



Cylinder Bore Cleaning

1. ⚠ **CAUTION: If these procedures are not followed, rusting of the cylinder bores may occur.**

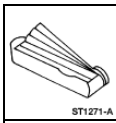
   Clean the cylinder bores with soap or detergent and water.

2. Thoroughly rinse with clean water and wipe dry with a clean, lint-free cloth.

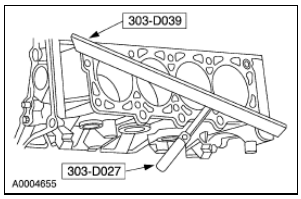
3. Use a clean, lint-free cloth and lubricate the cylinder bores.
   - Use clean engine oil meeting Ford specification.

Cylinder Block Distortion

Special Tool(s)

 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A) or equivalent
 ST1246-A	Straight Edge 303-D039 (D83L-4201-A) or equivalent

1. Use the special tools to inspect the cylinder block for flatness. If the cylinder block is distorted, install a new cylinder block. Refer to the appropriate section in Group 303 for the procedure.



Cylinder Block Core Plug Replacement

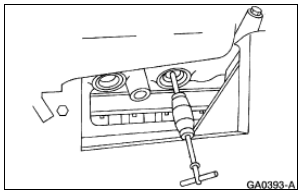
Special Tool(s)

 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

Item	Specification
Threadlock® 262 E2FZ-19554-B or equivalent	WSK-M2G351-A6

1. Use a slide hammer or tools suitable to remove the cylinder block core plug.


GA0393-A

2. Inspect the cylinder block plug bore for any damage that would interfere with the correct sealing of the plug. If the cylinder block plug bore is damaged, bore for the next oversize plug.

3. **NOTE:** Oversize plugs are identified by the OS stamped in the flat located on the cup side of the plug.

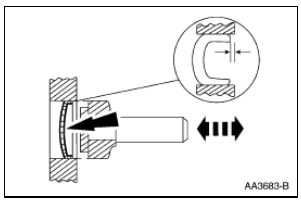
   Coat the cylinder block core plug and bore lightly with Threadlock® 262 and install the cylinder block core plug.

Cup-Type

4. ⚠ **CAUTION: Use care during this procedure so as not to disturb or distort the cup sealing surface.**

   ⚠ **CAUTION: When installed, the flanged edge must be below the chamfered edge of the bore to effectively seal the bore.**

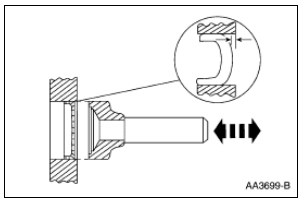
   Use a tool suitable to seat the cup-type cylinder block core plug.


AA3683-B

Expansion-Type

1. ⚠ **CAUTION: Do not contact the crown when installing an expansion-type cylinder block core plug. This could expand the plug before seating and result in leakage.**

   Use tool suitable to seat the expansion-type cylinder block core plug.

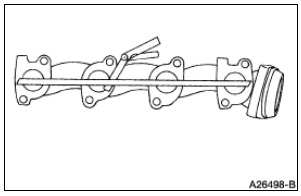


Exhaust Manifold Inspection

Special Tool(s)

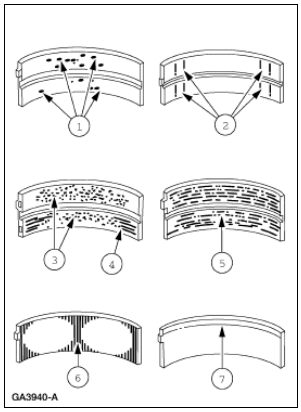
 ST1246-A	Straight Edge 303-D039 (D83L-4201-A) or equivalent

1. Place a straight edge across the exhaust manifold flanges and check for warping with a feeler gauge.


A26498-B

Bearing Inspection

1. Inspect bearings for the following defects. Possible causes are shown:
    1. Cratering fatigue failure.
    2. Spot polishing incorrect seating.
    3. Imbedded dirt engine oil.
    4. Scratching dirty engine oil.
    5. Base exposed poor lubrication.
    6. Both edges worn journal damaged.
    7. One edge worn journal tapered or bearing not seated.



General Specifications

Item	Specification
Lubricants and Sealants	
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP	WSS-M2C153-H
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Engine	
Displacement	3.0L (4V) (182 CID)
Number of cylinders	6
Bore	89.0 mm (3.5 in)
Stroke	79.5 mm (3.13 in)
Firing order	1-4-2-5-3-6
Oil pressure (hot 1,500 rpm)	138-310 kPa (20-45 psi)
Oil capacity (with filter change)	6.5 L (6.9 qts)
Compression ratio	TBD
Cylinder Head and Valve Train	
Cylinder head gasket surface flatness	0.12 mm (0.004 in)
Cylinder head gasket surface finish	TBD
Combustion chamber volume	45.7 ± 1.5 cc
Valve arrangement (front to rear)	TBD
Valve clearance intake	0.175-0.225 mm (0.0069-0.0089 in)
Valve clearance exhaust	0.325-0.375 mm (0.0128-0.0148 in)
Valve guide bore diameter	TBD
Valve stem diameter (standard) intake	5.492-5.477 mm (0.216-0.215 in)
Valve stem diameter (standard) exhaust	5.479-5.464 mm (0.215 in)
Valve stem-to-guide clearance intake	0.022-0.067 mm (0.0008-0.0026 in)
Valve stem-to-guide clearance exhaust	0.035-0.080 mm (0.001-0.003 in)
Valve head diameter intake	35 mm (1.38 in)
Valve head diameter exhaust	30 mm (1.18 in)
Valve head diameter gauge diameter	33.5 and 28.0 mm (1.318 and 1.102 in)
Valve face runout	0.02 mm (0.007 in)
Valve face angle	45.5 degrees
Valve seat width intake	1.1-1.4 mm (0.043-0.055 in)
Valve seat width exhaust	1.4-1.7 mm (0.055-0.066 in)
Valve seat runout	0.04 mm (0.001 in)
Valve seat angle	89-90 degrees
Valve spring free length (approx.)	44.2 mm (1.740 in)
Valve spring squareness	TBD

Valve spring compression pressure (N @ spec. length)	400 ± 22 at 24.5 mm (89.92 ± 4.94 at 0.964 in)
Valve spring installed height	TBD
Valve spring installed pressure (N @ spec. length)	175 ± 10 at 33.41 mm (39.34 ± 2.24 at 1.315 in)
Roller follower ratio	TBD
Rocker arm ratio	TBD
Camshaft	
Theoretical valve lift @ 0 lash	TBD
Lobe lift intake	8.466 mm (0.333 in)
Lobe lift exhaust	9.461 mm (0.372 in)
Allowable lobe lift loss	TBD
Journal diameter	26.929-26.936 mm (1.060 in)
Camshaft journal bore inside diameter	TBD
Camshaft journal-to-bearing clearance standard	0.025-0.076 mm (0.001-0.0029 in)
Camshaft journal-to-bearing clearance service limit	0.151 mm (0.005 in)
Runout	TBD
End play standard	0.07-0.15 mm (0.002-0.005 in)
End play service limit	0.277 mm (0.010 in)
Cylinder Block	
Cylinder bore diameter grade 1	89.000-89.010 mm (3.503-3.504 in)
Cylinder bore diameter grade 2	89.010-89.020 mm (3.504 in)
Cylinder bore diameter grade 3	89.020-89.030 mm (3.504-3.505 in)
Cylinder bore maximum taper	0.020 mm (0.0007 in)
Cylinder bore maximum out-of-round limit	0.015 mm (0.0005 in)
Cylinder bore maximum out-of-round service limit	0.020 mm (0.0007 in)
Main bearing bore inside diameter	67.998-68.022 mm (2.677-2.6780 in)
Head gasket surface flatness	TBD
Head gasket surface finish	0.12 mm (0.004 in)
Crankshaft	
Main bearing journal diameter	62.968-62.992 mm (2.467-2.479 in)
Main bearing journal maximum taper	TBD
Main bearing journal maximum out-of-round	TBD
Main bearing journal-to-cylinder block clearance	TBD
Connecting rod journal diameter	49.970-49.990 mm (1.967-1.968 in)
Connecting rod journal maximum taper	TBD
Connecting rod journal maximum out-of-round	TBD
Crankshaft maximum end play	0.110-0.232 mm (0.004-0.009 in)
Piston and Connecting Rod	
Piston diameter coded grade 1	88.990-89.010 mm (3.5035-3.5043 in)
Piston diameter coded grade 2	88.998-89.022 mm (3.5039-3.5048 in)
Piston diameter coded grade 3	89.010-89.030 mm (3.5043-3.5051 in)
Piston-to-cylinder bore clearance	0.012-0.022 mm (0.0005-0.0009 in)
Piston ring end gap compression (top, gauge diameter)	0.100-0.250 mm (0.0039-0.0098 in)

Piston ring end gap compression (bottom, gauge diameter)	0.27-0.42 mm (0.0106-0.0165 in)
Piston ring end gap oil ring (steel rail, gauge diameter)	0.15-0.65 mm (0.0059-0.0255 in)
Piston ring end gap compression (top, service limit)	0.50 mm (0.0196 in) max.
Piston ring end gap compression (bottom, service limit)	0.65 mm (0.0255 in) max.
Piston ring end gap oil ring (steel rail, service limit)	0.90 mm (0.0354 in) max.
Piston ring groove width compression (top)	1.230-1.245 mm (0.0484-0.0490 in)
Piston ring groove width compression (bottom)	1.530-1.545 mm (0.0602-0.0608 in)
Piston ring groove width oil ring	3.030-3.055 mm (0.1192-0.0120 in)
Piston ring width	TBD
Piston ring-to-groove clearance	TBD
Piston pin bore diameter	21.017-21.031 mm (0.827-0.828 in)
Piston pin diameter	21.011-21.013 mm (0.8272 in)
Piston pin length	60.51-60.08 mm (2.382-2.365 in)
Piston pin-to-piston fit	-0.005 to +0.001 mm (0.0001-0.00003 in)
Piston-to-connecting rod clearance	TBD
Connecting rod-to-pin clearance standard	0.004-0.020 mm (0.0001-0.0007 in)
Connecting rod-to-pin clearance service limit	0.035 mm (0.0013 in)
Connecting rod pin bore diameter	TBD
Connecting rod length (center-to-center)	138.06-138.14 mm (5.435-5.38 in)
Connecting rod maximum allowed bend	0.038 mm per 25.0 mm (0.0014 in per 0.984 in)
Connecting rod maximum allowed twist	0.050 mm per 25.0 mm (0.0019 in per 0.984 in)
Connecting rod bearing bore diameter	TBD
Connecting rod bearing-to-crankshaft clearance	0.028-0.045 mm (0.0011-0.0017 in)
Connecting rod side clearance (assembled to crank) standard	0.100-0.30 mm (0.0039-0.0118 in)
Connecting rod side clearance (assembled to crank) service limit	0.35 mm (0.0137 in) max.

Torque Specifications

Description	Nm	lb-ft	lb-in
Ignition coil bolts	6		53
Valve cover studs and bolts	10		89
Upper intake manifold bolts	10		89
Front intake manifold support nut	10		89
Lower intake manifold bolts	10		89
Coolant outlet tube bolts	25	18	
Coolant inlet tube bolts	25	18	
Crankshaft position sensor bolts	10		89
Camshaft journal cap bolts [a]			
Differential pressure feedback EGR nuts	6		53

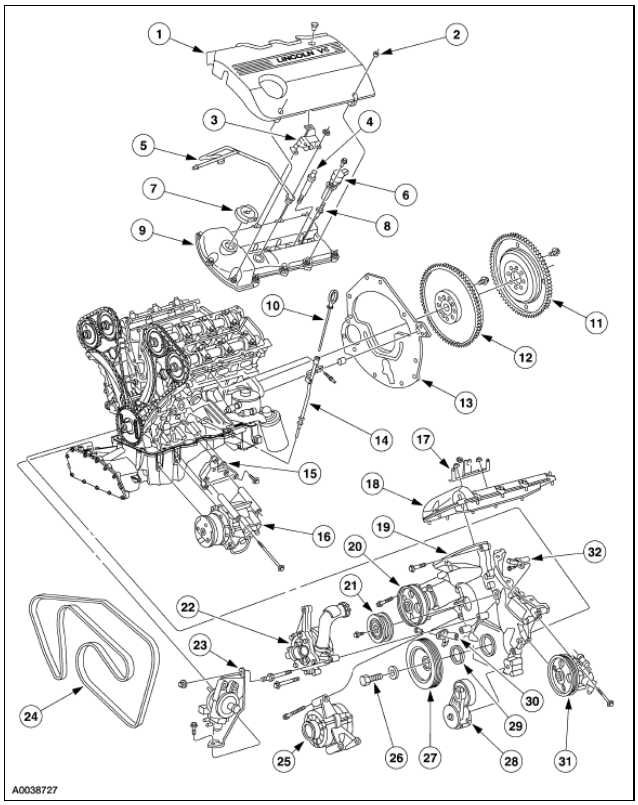
Camshaft position sensor bolt	10		89
Exhaust manifold nuts	20	15	
Oil level indicator tube stud bolt	10		89
Oil pan bolts	25	18	
Oil pressure switch	14	10	
Oil pump bolts	10		89
Oil separator bolts	10		89
Oil pump screen tube bolts	10		89
Oil filter adapter bolts	25	18	
Oil filter adapter bolt (large single) [a]			
EGR-to-exhaust manifold tube	40	30	
Upper intake support bolt	10		89
Upper intake support bracket nuts	6		53
Oil cooler bolt	57	42	
Spark plugs	15	11	
Upper intake support bracket nut	10		89
LH and RH engine mount nuts	63	46	
Power steering pump bolts	25	18	
Cable bracket bolt	10		89
A/C manifold bolt	21	15	
A/C line bracket	10		89
Secondary air tube connector	38	28	
Cylinder head bolts [a]			
Lower cylinder block bolts [a]			
Generator mounting bolts	48	35	
A/C compressor mounting bracket bolts	25	18	
Engine mount bolts	63	46	
Engine mount nuts	63	46	
Engine mount bracket bolts	25	18	
Flywheel bolts	80	59	
Connecting rod cap nuts [a]			
Front cover bolts and studs	25	18	
Crankshaft damper bolts [a]			
Belt tensioner bolt	48	35	
Belt idler pulley bolt	25	18	
Transmission cooler line bracket bolt	11		8
Torque converter nuts	35	25	
Cylinder head temperature sensor	15	11	
Timing chain guide bolts	25	18	
Timing chain tensioner bolts	25	18	
Exhaust manifold heat shield bolts	10		89
Power steering reservoir bolts	12	9	
Power steering pump bolts	25	18	
Power steering line bracket bolt	10		89

Hydraulic cooling fan pump bolts	25	18	
Hydraulic cooling fan reservoir bolts	12	9	
Water pump bolts and studs	25	18	
Cross vehicle support bolts	20	15	
Ground strap-to-body bolt	10		89
Ground strap-to-engine stud bolt and nut	10		89
Steering shaft clamp bolt	25	18	
Starter studs and bolt	25	18	
Transmission oil cooler lines	20	15	
Engine-to-transmission bolts	45	35	
Radio ignition interference capacitor bolts	10		89
Knock sensor bolts	25	18	
Front crossmember bolts	103	76	
Center crossmember bolts	103	76	
Lower strut mount bolts	175	129	
Upper ball joint nuts	90	66	
Lower stabilizer link nut	55	41	
Front brake caliper bolts	103	76	
Throttle cable bracket bolts	10		89
Upper radiator support bracket bolts	10		89
Fuel pressure sensor shield bolts	10		89
Fuel pressure sensor shield nuts	6		53
Wiring harness-to-valve cover bracket nuts	6		53
Fuel line bracket bolt	10		89
Appearance cover bracket nuts	6		53
Transmission-to-oil pan bolts	45	35	
Transmission cooler line bracket nut	10		89
A/C compressor bolts	25	18	
Subframe bolts	104	77	
Lower control arm through bolt	175	129	
Steering gear nuts	103	76	
Engine mount nuts (upper)	40	30	
Main engine wiring harness connector bolt	10		89
Cable bracket nut	10		89

[a] Refer to the procedure in this section.

Engine

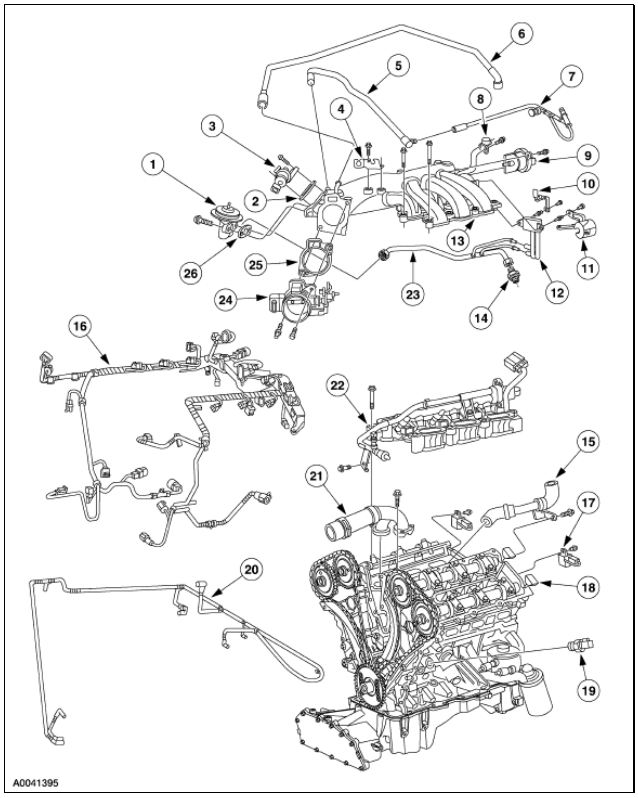
Engine Disassembled View



Item	Part Number	Description
1	6P068	Engine cover
2	6N030	Engine cover grommet
3	9J444	Appearance cover support bracket
4	6G004	Cylinder head temperature (CHT) sensor
5	6758	Crankcase vent tube
6	12A663	Ignition coil assembly
7	6766	Engine oil filler cap
8	12405	Spark plug
9	6A505	Valve cover LH
10	6750	Engine oil level indicator
11	6375	Flexplate assembly
12	6477	Dual mass flywheel assembly
13	6A373	Engine rear plate
14	6754	Engine oil level indicator tube
15	19N586	A/C compressor mounting bracket
16	19D269	A/C compressor
17	9J444	Intake support bracket
18	6582	Valve cover RH

19	6C086	Engine front cover assembly
20	8C648	Radiator cooling fan pump assembly
21	9C348	Accessory drive belt idler pulley
22	8501	Water pump assembly
23	9G442	Electronic thermactor air (ETA) valve and bracket
24	8620	Accessory drive belt
25	10300	Generator
26	W701512	Crankshaft pulley bolt
27	6316	Crankshaft pulley/damper
28	6B209	Accessory drivebelt tensioner
29	6700	Crankshaft front oil seal
30	6C315	Crankshaft position (CKP) sensor
31	3A696	Power steering pump
32	6B288	Camshaft position (CMP) sensor

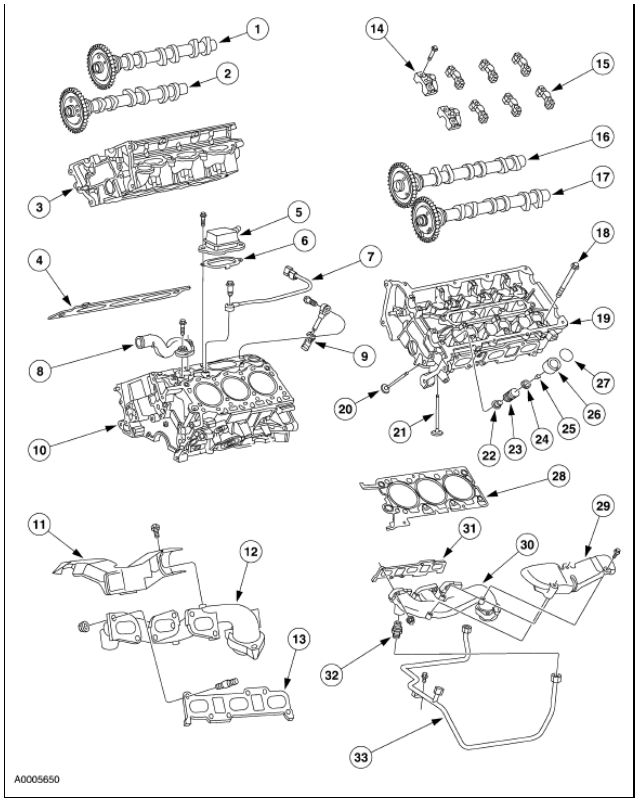
Engine Disassembled View



Item	Part Number	Description
1	9D960	Exhaust gas recirculation (EGR) valve
2	9F560	Air bypass valve gasket
3	9F716	Air bypass valve
4	9728	Accelerator cable bracket
5	9D289	Fuel vapor tube assembly
6	6C324	Positive crankcase ventilation (PCV) tube and valve assembly
7	9D289	Fuel vapor tube assembly

8	9J459	Electronic vacuum regulator (EVR) solenoid
9	9L490	Intake air control valve
10	9D736	Accelerator cable support bracket
11	9G609	Fuel pressure sensor shield
12	9J433	Differential pressure feedback EGR transducer
13	9424	Upper intake manifold
14	9F485	EGR tube to exhaust manifold connector
15	6C661	Crankcase vent tube and hose assembly
16	12B637	Wire harness assembly
17	18801	Radio ignition interference capacitor
18	6G017	Cap
19	9278	Oil pressure switch
20	9E498	Emission vacuum control harness
21	8548	Water bypass tube assembly
22	95447	Lower intake manifold assembly
23	9D477	EGR tube
24	9E926	Throttle body assembly
25	9E936	Throttle body gasket
26	9D476	EGR valve gasket

Engine Disassembled View



Item	Part Number	Description
1	6A268	Intake camshaft
2	6A266	Exhaust camshaft
3	6049	Cylinder head

4	6051	Cylinder head gasket
5	6B673	Crankcase vent oil separator assembly
6	6B752	Oil separator to cylinder block gasket
7	12A699	Knock sensor
8	6A560	Water inlet tube assembly
9	12A699	Knock sensor
10	6010	Cylinder block
11	9A462	Exhaust manifold heat shield
12	9430	RH exhaust manifold
13	9448	Exhaust manifold gasket
14	6B280	Camshaft bearing cap
15	6B280	Camshaft bearing cap
16	6A267	Intake camshaft
17	6A269	Exhaust camshaft
18	6065	Cylinder head bolt
19	6050	Cylinder head
20	6507	Intake valve
21	6505	Exhaust valve
22	6A517	Seal and seat assembly
23	6513	Valve spring
24	6514	Retainer
25	6518	Key
26	6500	Tappet
27	6K514	Shim
28	6083	Cylinder head gasket
29	9Y427	Exhaust manifold heat shield
30	9431	LH exhaust manifold
31	9448	Exhaust manifold gasket
32	9D439	ETA tube adapter
33	9B480	ETA tube

The 3.0L (4V) (182 CID) is a 60-degree V-6 engine with dual overhead camshafts (DOHC), four valves per cylinder and sequential multiport fuel injection (SFI). The engine has:

- an aluminum upper intake manifold.
- a lower intake manifold.
- aluminum cylinder heads.
- a cast aluminum upper cylinder block.

The ignition system is electronic (distributorless) with a single ignition coil located above each spark plug. This high-energy ignition system is required for fast-burn combustion.

A unique intake air system utilizes two separate plenums, one for each side of the engine. The plenums can be connected through the operation of a special intake manifold tuning (IMT) valve to improve upper rpm power.

Identification

For quick identification refer to the safety certification decal:

- The decal is located on the LH front door lock face panel.
- An engine identification label is also attached to the engine.
- The symbol code on the identification tag identifies each engine for determining parts usage; for instance, engine displacement in liters or cubic inch displacement and model year.

Engine Code Information

The engine code information label is located on the front fender. The label contains, among other information:

- the engine calibration number.
- the engine build date.
- the engine plant code.
- the engine code.

Emission Calibration Label

NOTE: The engine codes and the calibration numbers must be used when making inquiries or ordering parts.

The emission calibration number label is located on the LH side door or LH door post pillar. It identifies:

- the engine calibration number.
- the engine code number.
- the revision level.

These numbers are used to determine if parts are unique to specific engines.

Exhaust Emission Control System

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Induction System

The fuel needed for burning in the cylinders is provided by a returnless, sequential multiport fuel injection (SFI).

- Fuel is supplied from the vehicle fuel tank by a high-pressure electric fuel pump mounted in the fuel tank.
- The fuel is filtered and sent to the fuel injection supply manifold.
- Fuel pressure is regulated by modulating pump output based upon readings from the fuel pressure sensor, located on the fuel rail.
- Fuel is metered into the intake air stream in accordance with engine by six solenoid-operated fuel injectors mounted in the lower intake manifolds.
- The six fuel injectors are mounted above the intake valves and connected in series with the fuel pressure regulator.
- These fuel induction systems are mounted on a phenolic resin intake manifold.

Crankshaft

The crankshaft is supported on the bottom of the cylinder block by four steel-backed, over-plated, aluminum crankshaft main bearings.

To provide smooth engine operation, the piston crankpins are positioned to provide a power impulse every 120 degrees of crankshaft rotation. The spacing provides smooth and quiet operation.

Two sprockets and timing chains connect the crankshaft with the camshafts and provide a 2:1 drive ratio.

Camshaft

The camshafts:

- are supported on four bearing inserts.
- thrust loads and end play are limited by a camshaft thrust plate.

Cylinder Head

The spark plug is installed in the center of the fuel/air roof-shaped combustion chamber to ignite the mixture in the combustion chamber. The central location of the spark plug causes the flame front to be evenly spread across the chamber, which also reduces spark knock.

Valve Train

Both camshafts are driven by a shared timing chain, and operate four valves per cylinder by means of a selective shim sitting on the top of a tappet. One spring on each valve is used to close the valve. The adjusting shims in the valve tappets can be changed to correct the valve clearance. These are available in 44 different thicknesses. The shim thickness is ink printed on the back of the shim. Using a special procedure, the camshafts can be lifted without timing chain disassembly to change the shims. A high degree of accuracy is required during adjusting to avoid repeated changing of the shims. The camshaft cams run concentrically on the valve tappets. At engine speeds of about 3,000 rpm this causes the tappets to rotate, and they in turn transfer the rotation to the valves. This valve rotation is required because it produces an even valve seating and prevents the valves from wearing in a certain position which could cause them to leak.

Positive Crankcase Ventilation System

The engine is equipped with a positive, closed-type crankcase ventilation system which recycles the crankcase vapors to the throttle body.

Engine Lubrication System

The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to the crankshaft, connecting rod bearings and timing chain tensioners. The flow of oil to the valve tappets and valve train is controlled by a restricting orifice located in the head gaskets.

Oil Pump

The lubrication system is designed to provide optimum oil flow to critical components of the engine through its entire operating range.

The heart of the system is a positive displacement internal gear oil pump. Generically this design is known as a G-rotor pump.

- The oil pump is mounted on the front face of the cylinder block.
- The inner rotor is piloted on the crankshaft post and is driven through the crankshaft.

System pressure is limited by an integral, internally vented relief valve which directs the bypassed oil back to the inlet side of the oil pump.

- Oil pump displacement has been selected to provide adequate volume so there is correct oil pressure both at hot idle and maximum speed.

- Relief valve calibration protects the system from excessive pressure during high viscosity conditions, yet is designed to provide adequate connecting rod bearing lubrication under high temperature and high speed conditions.

Engine Cooling System

The engine is liquid-cooled by a centrifugal water pump driven through the front engine accessory drive by the crankshaft.

A water thermostat is used to restrict coolant flow until the engine reaches normal operating temperature.

Oil Pan

The oil pan is cast aluminum and is attached to the cylinder block and transmission.

- The oil pan acts as a reservoir holding lubricating oil that is pumped through the engine by the oil pump after start-up.

Drive Belt System

Accessories mounted on the front of the engine are belt-driven by the crankshaft and an automatically tensioned serpentine drive belt is routed over the following components:

- water pump
- A/C compressor
- generator
- drive belt tensioner
- drive belt idler pulley
- crankshaft pulley
- power steering pump pulley
- cooling fan pump pulley

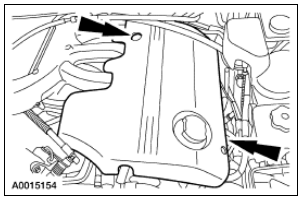
Engine

Refer to Section 303-00 .

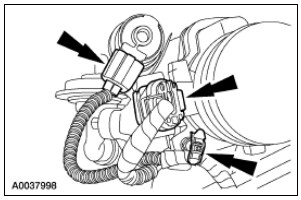
Upper Intake Manifold

Removal

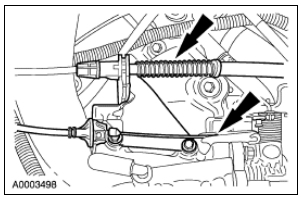
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Drain the engine cooling system. For additional information, refer to Section 303-03 .
3. Remove the engine appearance cover.



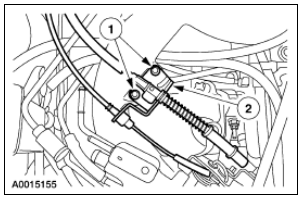
4. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
5. Disconnect the throttle position (TP) sensor and the idle air control (IAC) solenoid electrical connectors. Disconnect the wire retainer from the stud.



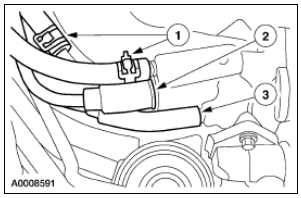
6. Disconnect the accelerator and speed control cables.



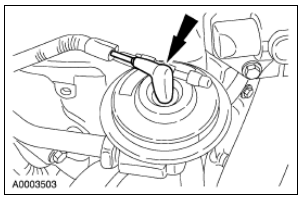
7. Remove the cable bracket.
    1. Remove the bolts.
    2. Remove the bracket.



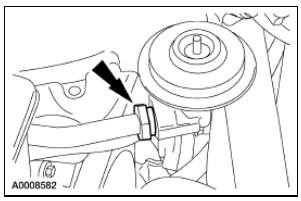
8. Disconnect the throttle body hoses.
    1. Disconnect the coolant hoses.
    2. Disconnect the positive crankcase ventilation (PCV) hose.
    3. Disconnect the vapor purge hose.



9. Disconnect the vacuum hose.

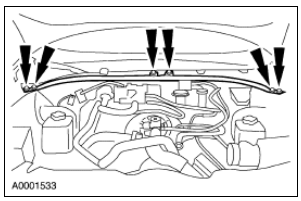


10. Disconnect the exhaust manifold-to-exhaust gas recirculation (EGR) valve tube nut.

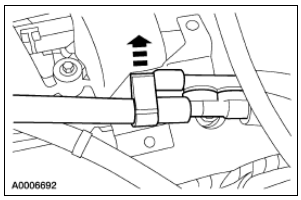


11. Remove the cowl vent screen. For additional information, refer to Section 501-02 .

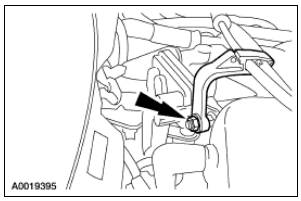
12. Remove the brace.



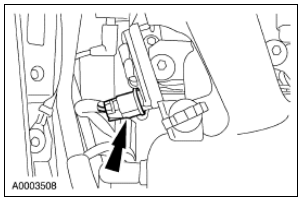
13. Remove the vacuum hoses from the mounting bracket.



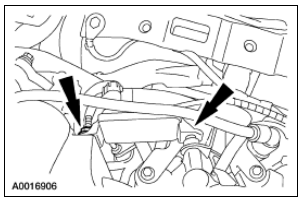
14. Remove the bracket and position the accelerator and cruise control aside.



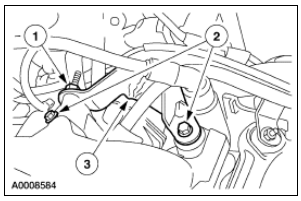
15. Disconnect the differential pressure feedback EGR electrical connector.



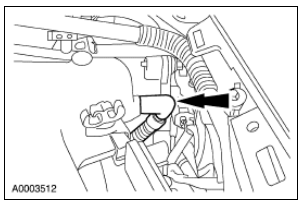
16. Remove the stud and nut and position the differential pressure feedback EGR transducer aside.



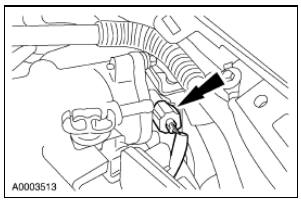
17. Remove the fuel pressure sensor shield.
    1. Remove the nut.
    2. Remove the bolts.
    3. Remove the shield.



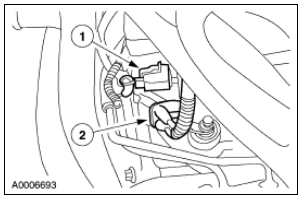
18. Disconnect the vacuum hose from the rear of the upper intake manifold.



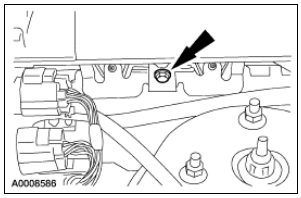
19. Disconnect the intake manifold tuning (IMT) valve electrical connector.



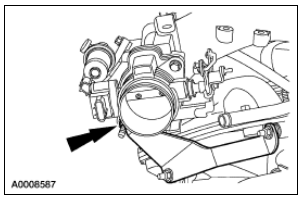
20. Disconnect the EGR vacuum regulator solenoid.
    1. Disconnect the electrical connector.
    2. Disconnect the vacuum line.



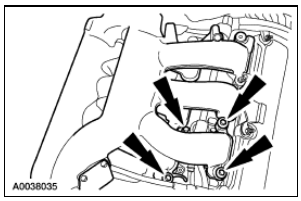
21. Remove the upper intake support bolt.



22. Remove the front intake manifold support bolt.

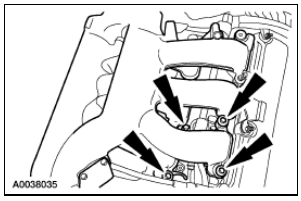


23. Remove the bolts and the upper intake manifold.
    - Inspect the gaskets. Install new gaskets if necessary.

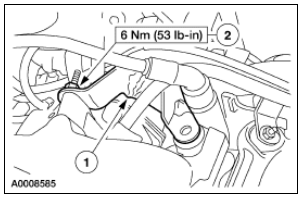


Installation

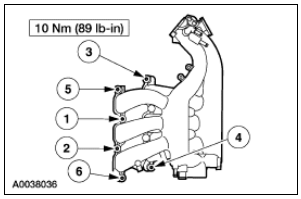
1. Position the upper intake manifold and install the bolts hand tight.



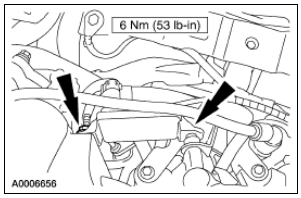
2. Install the fuel pressure sensor shield.
    1. Position the shield.
    2. Install the nut.



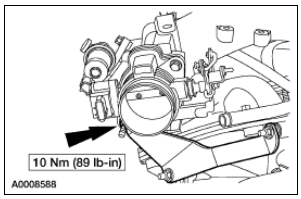
3. Tighten the upper intake manifold bolts in the sequence shown.



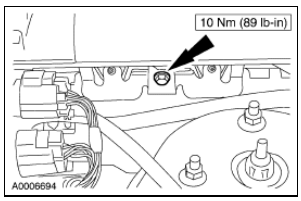
4. Position the differential pressure feedback EGR and install the nut and stud.



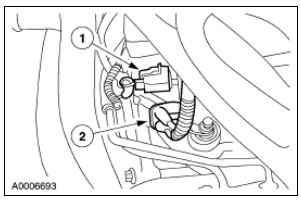
5. Install the upper intake manifold support bolt.



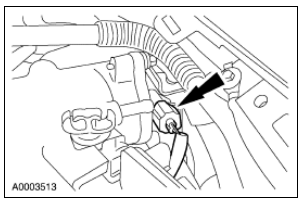
6. Install the upper intake support bolt.



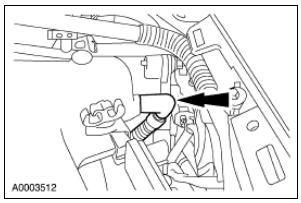
7. Connect the EGR vacuum regulator solenoid.
    1. Connect the electrical connector.
    2. Connect the vacuum line.



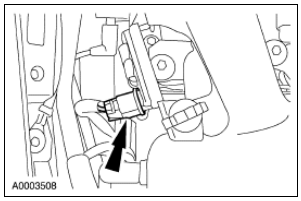
8. Connect the intake manifold tuning (IMT) valve electrical connector.



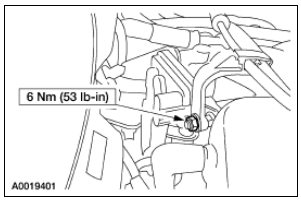
9. Connect the vacuum hose to the rear of the upper intake manifold.



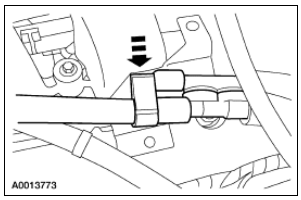
10. Connect the differential pressure feedback EGR electrical connector.



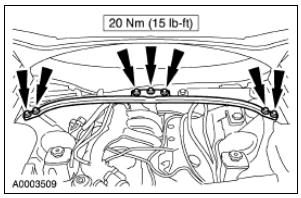
11. Position the accelerator and cruise control cables and install the bracket.



12. Clip the vacuum hoses into the mounting bracket.

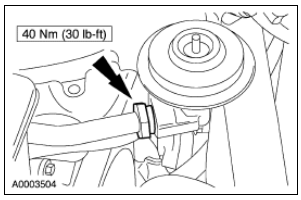


13. Install the brace.

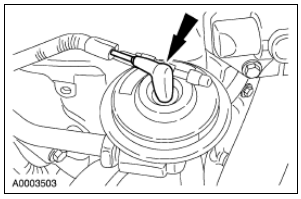


14. Install the cowl vent screen. For additional information, refer to Section 501-02 .

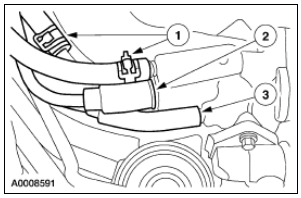
15. Connect the exhaust manifold-to-EGR tube nut.



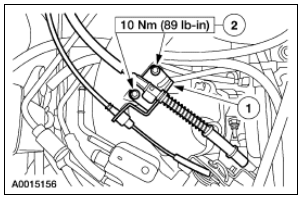
16. Connect the vacuum hose.



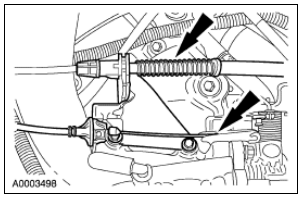
17. Connect the throttle body hoses.
    1. Connect the coolant hoses.
    2. Connect the PCV hose.
    3. Connect the vapor purge hose.



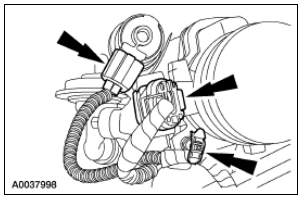
18. Install the cable bracket.
    1. Position the bracket.
    2. Install the bolts.



19. Connect the accelerator and speed control cables.

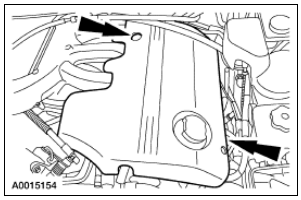


20. Connect the TP sensor and the IAC solenoid electrical connectors.



21. Install the air cleaner outlet tube. For additional information, refer to Section 303-12 .

22. Install the engine appearance cover.



23. Fill the engine cooling system. For additional information, refer to Section 303-03 .

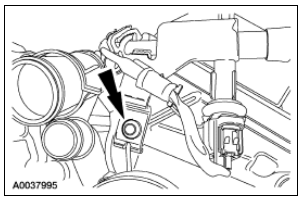
24. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Lower Intake Manifold

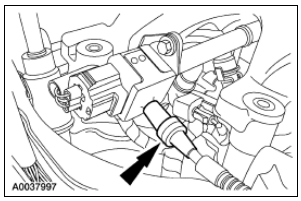
Removal

1. Remove the upper intake manifold. For additional information, refer to Upper Intake Manifold .
2. Disconnect the fuel hose. For additional information, refer to Section 310-00 .
3. **NOTE:** Engine remove for clarity.

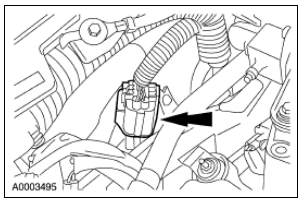
   Remove the fuel hose bracket bolt.



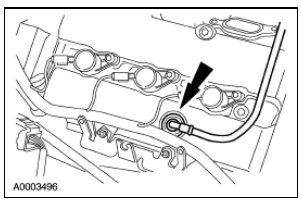
4. Disconnect the fuel pressure sensor vacuum hose.



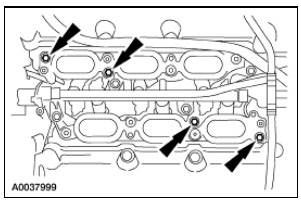
5. Disconnect the fuel charging wiring harness connector.



6. Disconnect the crankcase ventilation tube and position out of the way.

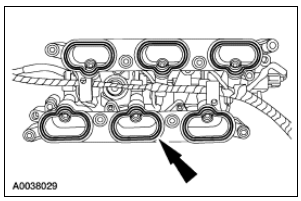


7. Remove the bolts and the lower intake manifold.

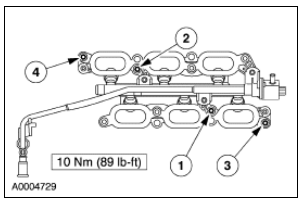


Installation

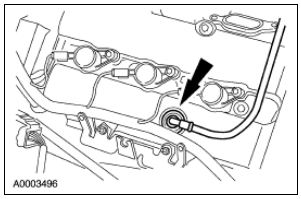
1. Clean and inspect the lower intake manifold gaskets. Install new gaskets if necessary.



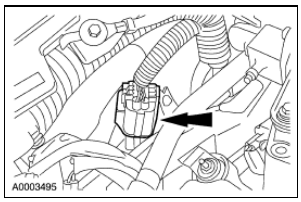
2. Position the lower intake manifold and install the bolts in the sequence shown.



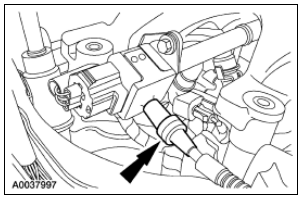
3. Connect the crankcase ventilation tube.



4. Connect the fuel charging wiring harness connector.

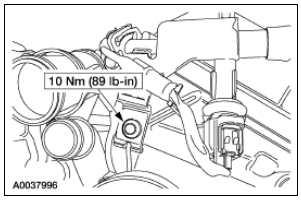


5. Connect the fuel pressure sensor vacuum hose.



6. **NOTE:** Engine removed for clarity.

   Install the fuel hose bracket bolt.



7. Connect the fuel hose. For additional information, refer to Section 310-00 .

8. Install the upper intake manifold. For additional information, refer to Upper Intake Manifold .

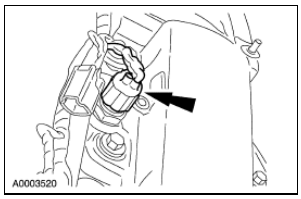
Valve Cover LH

Material

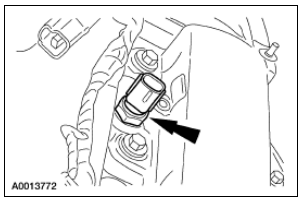
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4

Removal

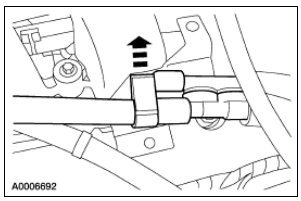
1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .
2. Remove the LH ignition coils. For additional information, refer to Section 303-07A .
3. Disconnect the cylinder head temperature (CHT) electrical connector.



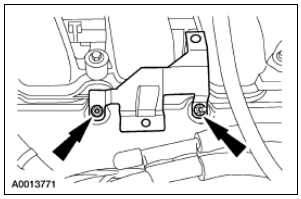
4. Remove the CHT sensor.



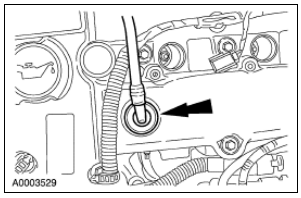
5. Remove the vacuum hoses from the appearance cover support bracket.



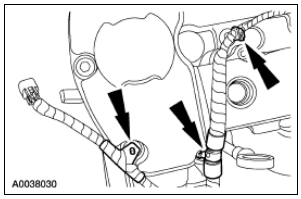
6. Remove the nuts and the appearance cover support bracket.



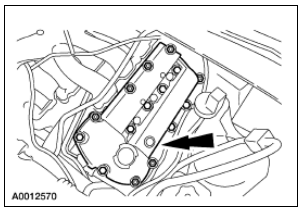
7. Disconnect the positive crankcase ventilation (PCV) tube and position aside.



8. Remove the ignition coil wiring harness from the retainers.



9. Remove the studs, bolts, and the valve cover.
    - Discard the gasket.
    - Clean the sealing surfaces.

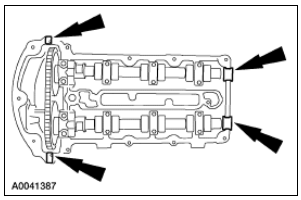


Installation

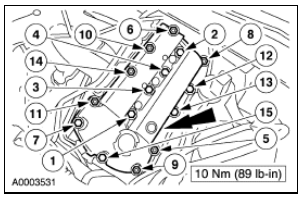
1. **NOTE:** The valve cover must be installed within four minutes of sealer application.

   Apply an 8 mm (0.32 in) bead of silicone gasket and sealant to the cylinder half round surface and to the front cover intersection places.

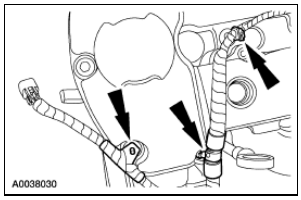
    - Install a new gasket.



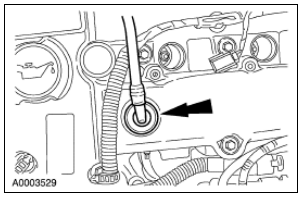
2. Position the valve cover and install the bolts and studs in the sequence shown.



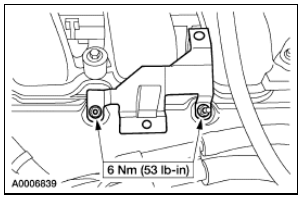
3. Install the ignition coil wiring harness onto the retainers.



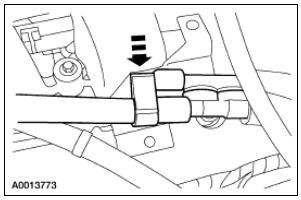
4. Connect the PCV tube.



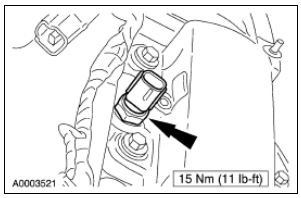
5. Install the appearance cover support bracket.



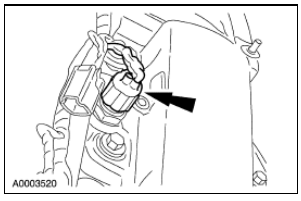
6. Install the vacuum hoses to the appearance cover support bracket.



7. Install the CHT sensor.



8. Connect the CHT electrical connector.



9. Install the LH ignition coils. For additional information, refer to Section 303-07A .

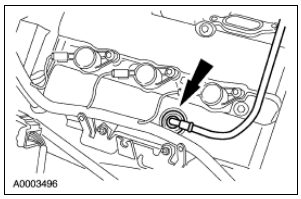
Valve Cover RH

Material

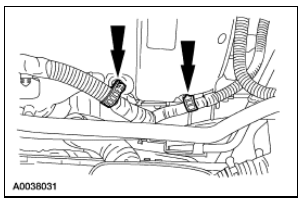
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4

Removal

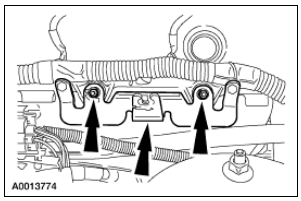
1. Remove the RH ignition coils. For additional information, refer to Section 303-07A .
2. Disconnect the positive crankcase ventilation (PCV) tube and position aside.



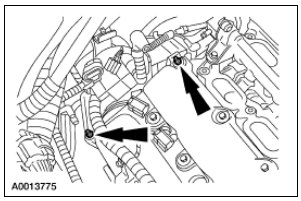
3. Remove the wiring harness retainers from the studs.



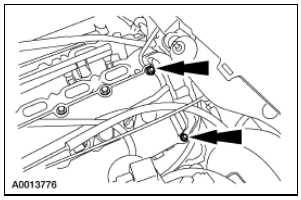
4. Remove the nuts and position the upper intake manifold support bracket aside.



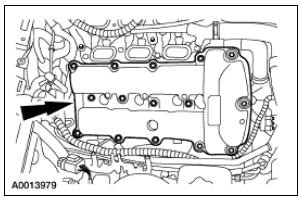
5. Remove the wiring harness bracket nuts.



6. Remove the wiring harness bracket nuts and position the wiring harness aside.



7. Remove the studs, bolts and the valve cover.
    - Discard the gasket.
    - Clean the sealing surfaces.

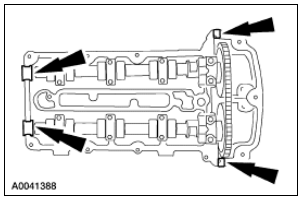


Installation

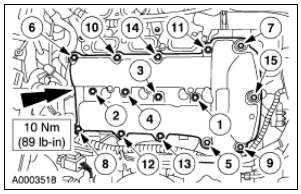
1. **NOTE:** The valve cover must be installed within four minutes of sealer application.

   Apply an 8 mm (0.32 in) bead of silicone gasket and sealant to the cylinder half round surface and to the front cover intersection places.

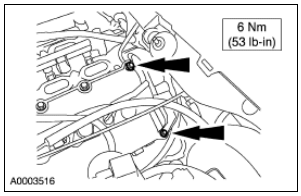
    - Install a new gasket.



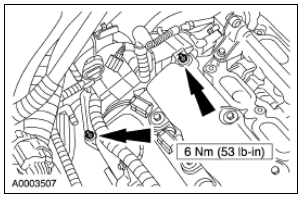
2. Position the valve cover and install the bolts and studs in the sequence shown.



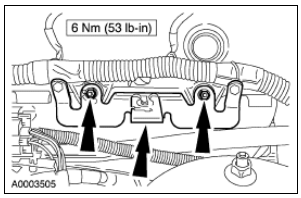
3. Install the wiring harness bracket and nuts.



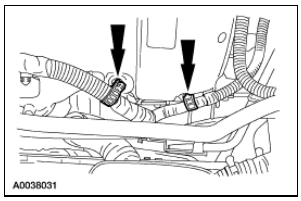
4. Install the wiring harness bracket nuts.



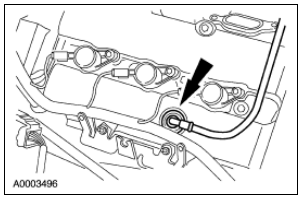
5. Install the upper intake manifold support bracket.



6. Install the wiring harness retainer onto the studs.



7. Connect the PCV tube.



8. Install the RH ignition coils. For additional information, refer to Section 303-07A .

Crankshaft Pulley

Special Tool(s)

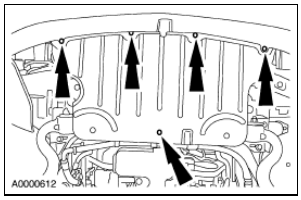
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST1184-A	3-Jaw Puller 303-D121 or equivalent
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A)

Material

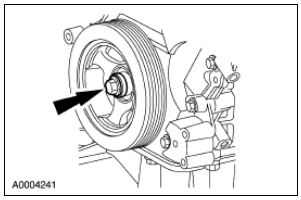
Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4

Removal

1. Remove the accessory drive belt. For additional information, refer to Section 303-05 .
2. If equipped, remove the secondary air valve, bracket and tube. For additional information, refer to Section 303-08 .
3. Raise and support the vehicle. For additional information, refer to Section 100-02 .
4. Remove the front center splash panel.

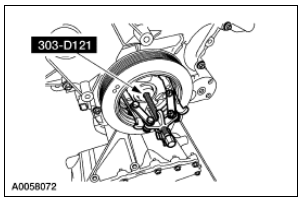

A0000612

5. Remove the crankshaft pulley bolt and washer.
   - Discard the bolt.


A0004241

6. ⚠ **CAUTION: The special tool must grab the inside of the damper or damage to the damper can occur.**

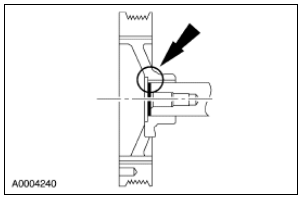
   Using the special tool, remove the crankshaft damper.



Installation

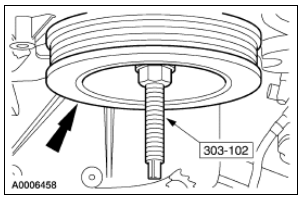
1. **NOTE:** Seal surface must be free of dirt and oil.

   Apply silicone gasket and sealant to the end of the keyway slot.

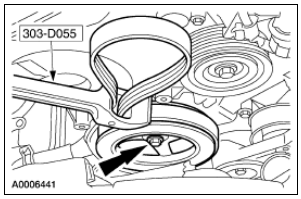


2. **NOTE:** Lubricate the outside diameter sealing surface of the crankshaft pulley with clean engine oil.

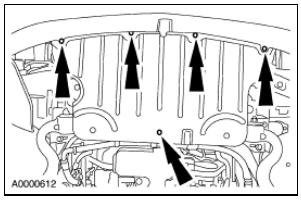
   Using the special tool, install the crankshaft pulley assembly.



3. Using the special tool, install a new bolt and the washer.
   - Tighten the bolt in four stages.
   - Stage 1: Tighten to 120 Nm (89 lb-ft).
   - Stage 2: Loosen one full turn (360 degrees).
   - Stage 3: Tighten to 50 Nm (37 lb-ft).
   - Stage 4: Tighten an additional 90 degrees.



4. Install the front center splash panel.



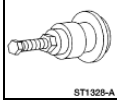
5. Lower the vehicle.

6. If equipped, install the secondary air valve, bracket and tube. For additional information, refer to Section 303-08 .

7. Install the accessory drive belt. For additional information, refer to Section 303-05 .

Crankshaft Front Oil Seal

Special Tool(s)

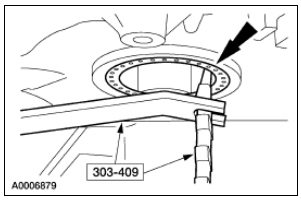
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)

Material

Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

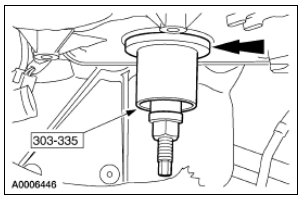
Removal

1. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.
2. Using the special tool, remove the crankshaft front oil seal.



Installation

1. Lubricate the inside diameter of the seal with clean engine oil.
2. Using the special tool, install the crankshaft front oil seal.



3. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

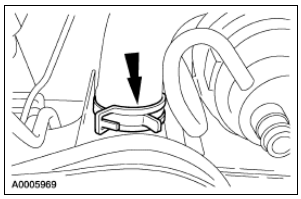
Engine Front Cover

Material

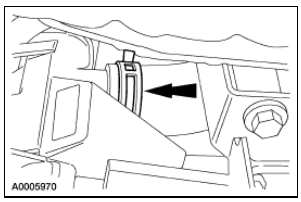
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4

Removal

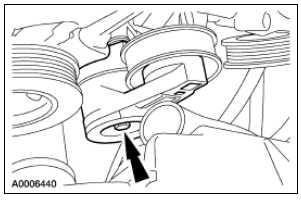
1. Remove the RH valve cover. For additional information, refer to Valve Cover RH in this section.
2. Remove the LH valve cover. For additional information, refer to Valve Cover LH in this section.
3. Remove the belt idler pulley. For additional information, refer to Section 303-05 .
4. Remove the water pump. For additional information, refer to Section 303-03 .
5. Disconnect the upper hose from the radiator.



6. Disconnect the lower hose from the radiator.

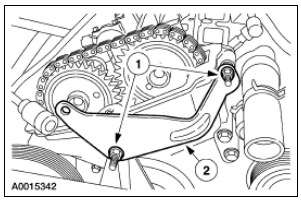


7. Remove the oil pan. For additional information, refer to Oil Pan in this section.
8. Remove the power steering pump. For additional information, refer to Section 211-02 .
9. Remove the hydraulic cooling fan pump. For additional information, refer to Section 303-03 .
10. Remove the bolt and the belt tensioner.

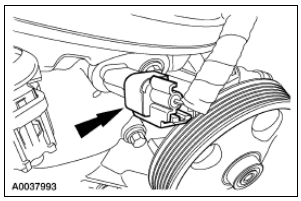


11. Remove the crankshaft front oil seal. For additional information, refer to Crankshaft Front Oil Seal in this section.

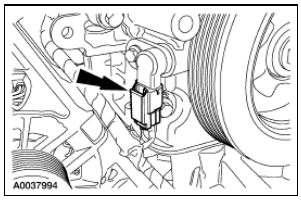
12. Remove the bracket.



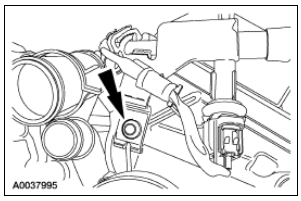
13. Disconnect the camshaft position (CMP) sensor electrical connector.



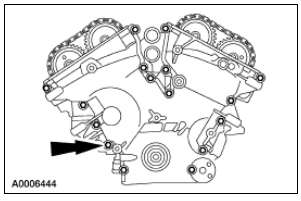
14. Disconnect the crankshaft position (CKP) sensor electrical connector.



15. Remove the fuel supply manifold bolt.



16. Remove the bolts and the engine front cover.
    - Discard the gasket.



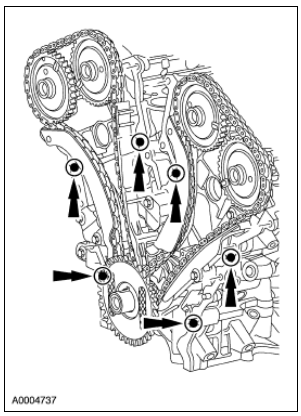
Installation

1. Clean the sealing surfaces on the engine and the front cover.

2. **NOTE:** Install the engine front cover within four minutes of sealer application.

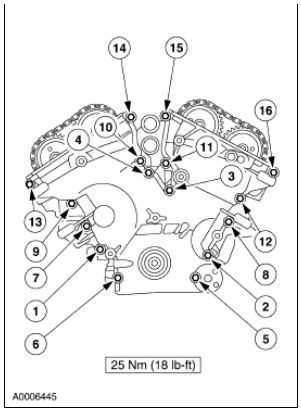
   Apply a 6 mm (0.24 in) diameter dot of silicone gasket and sealant to the areas indicated.

- Install a new gasket.

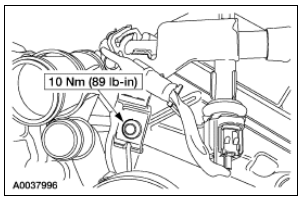


3. **NOTE:** Number 14 is a stud and washer assembly.

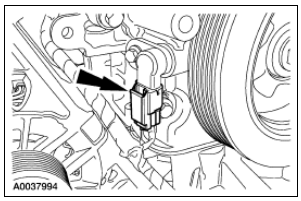
   Position the front cover and tighten the bolts in the sequence shown.



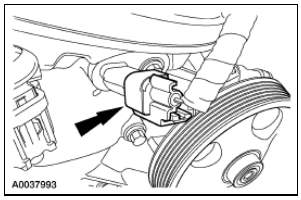
4. Install the fuel supply manifold bolt.



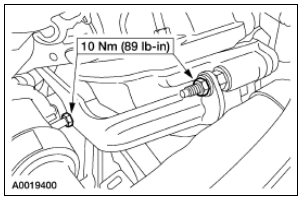
5. Connect the CKP sensor electrical connector.



6. Connect the CMP sensor electrical connector.

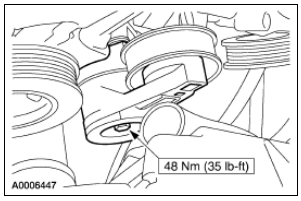


7. Install the bracket.



8. Install the crankshaft front oil seal. For additional information, refer to Crankshaft Front Oil Seal in this section.

9. Position the belt tensioner and install the bolt.

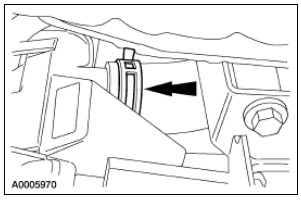


10. Install the hydraulic cooling fan pump. For additional information, refer to Section 303-03 .

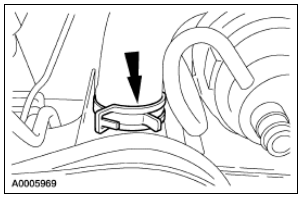
11. Install the power steering pump. For additional information, refer to Section 211-02 .

12. Install the oil pan. For additional information, refer to Oil Pan in this section.

13. Connect the lower hose to the radiator.



14. Connect the upper hose to the radiator.



15. Install the water pump. For additional information, refer to Section 303-03 .

16. Install the belt idler pulley. For additional information, refer to Section 303-05 .

17. Install the LH valve cover. For additional information, refer to Valve Cover LH in this section.

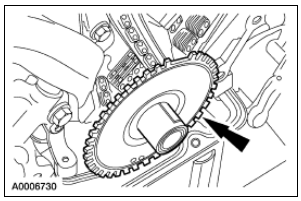
18. Install the RH valve cover. For additional information, refer to Valve Cover RH in this section.
19. Fill the cooling system. For additional information, refer to Section 303-03 .

Timing Drive Components

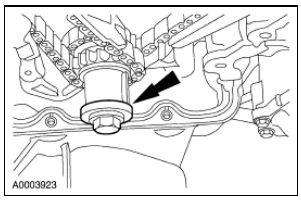
Removal

1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.

2. Remove the ignition pulse ring.

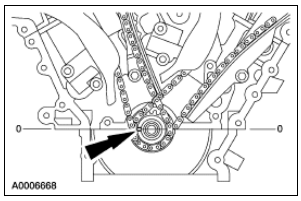


3. Reinstall the crankshaft damper bolt and washer.



4. ⚠ **CAUTION: Rotating the crankshaft in a counterclockwise direction can cause engine damage. Crankshaft journals are directionally machined. Rotating the crankshaft counterclockwise can raise burrs on bearing surfaces, reducing engine life.**

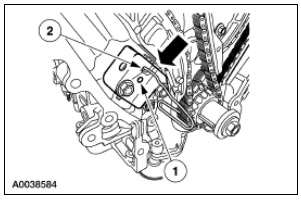
   Rotate the crankshaft clockwise to position the crankshaft keyway to the nine o'clock position.



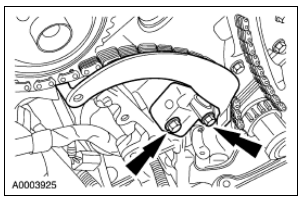
5. ⚠ **CAUTION: If the RH timing chain tensioner arm and RH chain guide are to be reused, mark the position of each piece to make sure that they are installed on the correct side when reassembled.**

   Compress the timing chain tensioner.

   1. Release the racheting pawl.
   2. Compress the timing chain tensioner and install a stiff wire or paper clip.

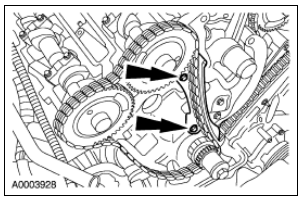


6. Remove the bolts, the timing chain tensioner and the tensioner arm.



7. Remove the RH timing chain.

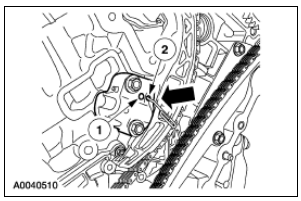
8. Remove the bolts and the RH timing chain guide.



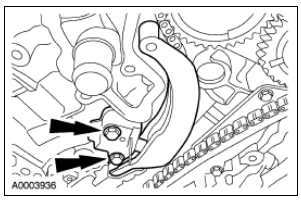
9. ⚠ **CAUTION: If the LH timing chain tensioner arm and the LH chain guide are to be reused, mark the position of each piece to make sure that they are installed on the correct side when reassembled.**

   Compress the timing chain tensioner.

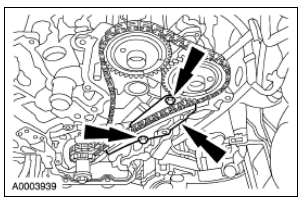
   1. Release the racheting pawl.
   2. Compress the timing chain tensioner and install a stiff wire or paper clip.



10. Remove the bolts, the timing chain tensioner and the tensioner arm.



11. Remove the bolts and LH chain guide.

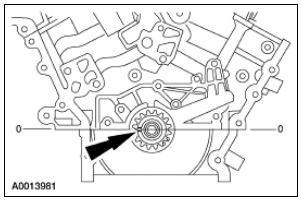


12. Remove the LH timing chain.

Installation

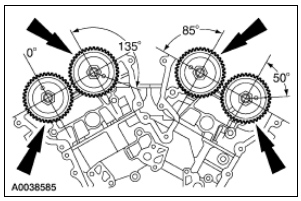
1. **⚠ CAUTION: Rotating the crankshaft in a counterclockwise direction can cause engine damage. Crankshaft journals are directionally machined. Rotating the crankshaft counterclockwise can raise burrs on bearing surfaces, reducing engine life.**

   Verify that the crankshaft keyway is in the nine o'clock position.

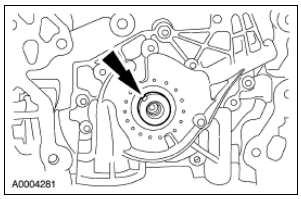


2. **⚠ CAUTION: The crankshaft keyway must remain in the nine o'clock position until the cams are located, or damage to the valves may occur.**

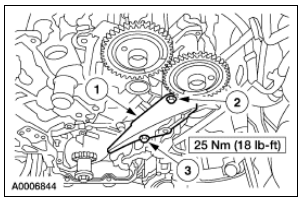
   Rotate the LH and RH intake and exhaust camshafts to locate them in their neutral positions.



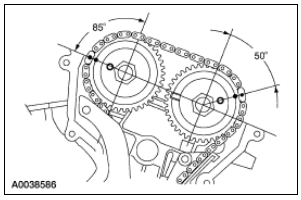
3. Rotate the crankshaft clockwise to position the keyway to the 11 o'clock position and remove the crankshaft damper bolt and washer.



4. Install the LH timing chain guide.
   1. Position the guide to the engine.
   2. Install the shorter (gold color) bolt into the upper hole.
   3. Install the longer bolt (black color) into the lower hole.

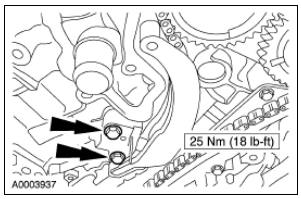


5. Install the LH timing chain, aligning the timing index link (gold color) with the marks on the camshaft and crankshaft sprockets.

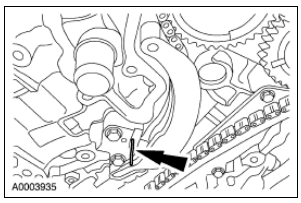


6. **NOTE:** Be sure to position the tensioner so that the tensioner piston is fully engaged in the tensioner arm.

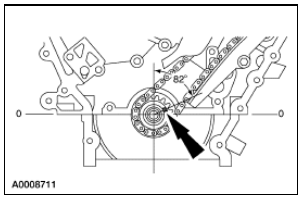
   Install the LH tensioner arm, tensioner and bolts.



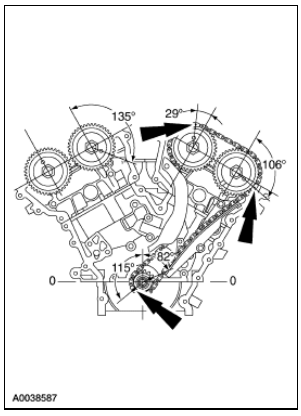
7. Remove the wire or paper clip from the tensioner.



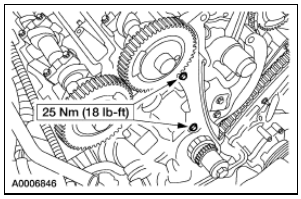
8. Rotate the crankshaft clockwise and position the keyway between the two o'clock and three o'clock positions for RH timing chain installation.



9. Verify that the timing index links (gold color) on the LH timing chain are in alignment with the timing index marks on the camshaft and crankshaft sprockets.

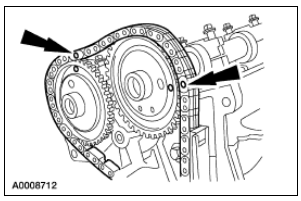


10. Install the RH chain guide and bolts.

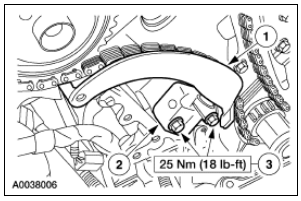


11. Install the RH timing chain, aligning the timing index links (gold color) with the marks on the

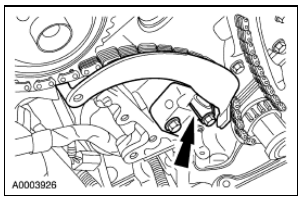
camshaft and crankshaft sprockets.



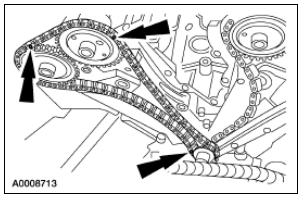
12. Install the RH tensioner.
    1. Position the tensioner arm.
    2. Position the tensioner.
    3. Install the bolts.



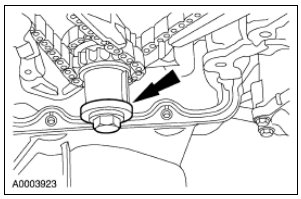
13. Remove the wire or paper clip from the RH tensioner.



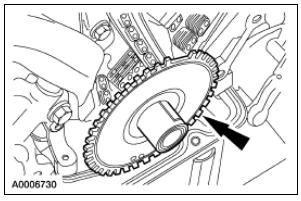
14. Verify that the timing index links (gold color) on the RH timing chain are in alignment with the timing index marks on the camshaft and crankshaft sprockets.



15. Remove the bolt and washer.



16. Install the ignition pulse ring.



17. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

Camshafts LH

Material

Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

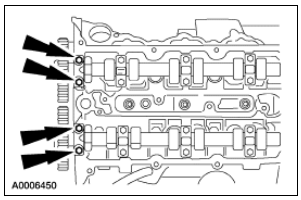
Removal

1. Remove the timing chains. For additional information, refer to Timing Drive Components in this section.

2. **⚠ CAUTION: Remove the camshaft journal thrust caps prior to loosening other camshaft journal cap bolts. Damage to the camshaft journal thrust cap can occur if not removed first.**

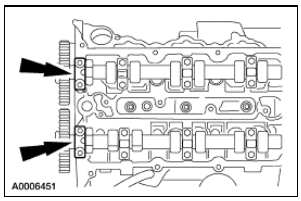
   ⚠ CAUTION: Cylinder head camshaft journal caps and cylinder heads are numbered to be sure they are assembled in their original positions. Keep camshaft journal caps with the cylinder head from which they were removed. Do not mix with camshaft journal caps from another cylinder head.

   Remove the bolts.

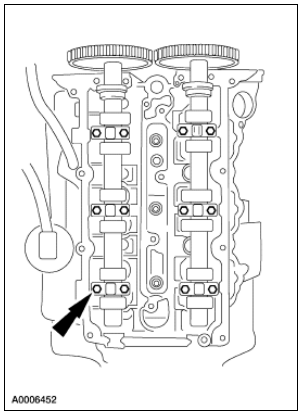


3. **NOTE:** The camshaft journal thrust caps have alignment dowels.

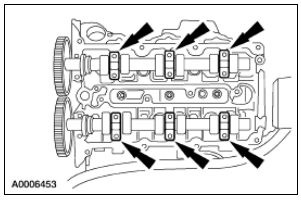
   Using a soft-faced mallet, gently loosen and remove the camshaft journal thrust caps.



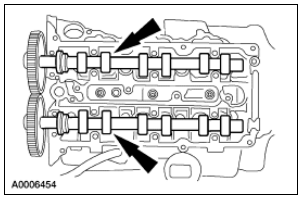
4. Remove the remaining camshaft journal bolts.



5. Using a soft-faced mallet, gently loosen and remove the remaining camshaft journal caps.



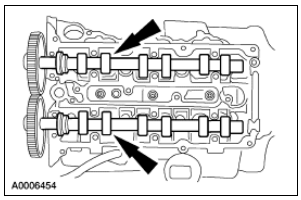
6. Carefully lift out the camshafts.



Installation

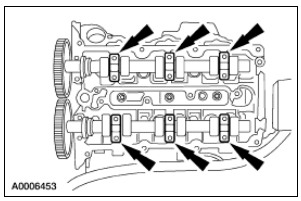
1. **NOTE:** Be sure camshaft bearing caps are installed in their original positions.

   Lubricate camshafts with clean engine oil and carefully position the camshafts into the cylinder head.

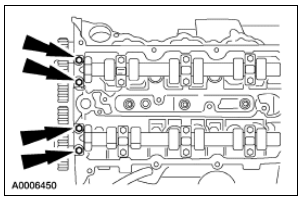


2. ⚠ **CAUTION: Do not install the camshaft journal thrust caps until all of the camshaft bearing caps have been installed, or damage to the thrust caps can occur.**

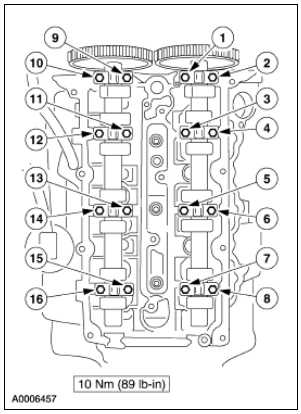
   Lubricate the bearing surfaces of the camshaft bearing caps with clean engine oil, install the bearing caps, and loosely install the bolts.



3. Lubricate the bearing surfaces of the camshaft caps with clean engine oil, install the caps, and loosely install the bolts.



4. Tighten the bolts in sequence shown.



5. **NOTE:** If new camshafts were installed, refer to Valve Spring Lash Adjustment in this section.

   Lubricate the tappet shims and camshaft lobes with clean engine oil.

6. ⚠ **CAUTION: Verify that the crankshaft is in the nine o'clock position before rotating the camshafts, or damage to the valve train may result.**

   Rotate the camshafts to be sure they are not binding. If binding occurs, check to make sure that all bearing caps are in their original positions. Loosen all bearing cap bolts in reverse order and retighten.

7. Install the timing chains. For additional information, refer to Timing Drive Components in this section.

Camshafts RH

Material

Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

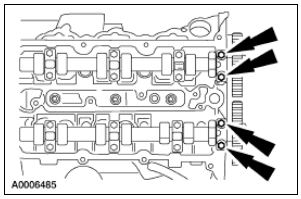
Removal

1. Remove the timing chains. For additional information, refer to Timing Drive Components in this section.

2. **⚠ CAUTION: Remove the camshaft journal thrust caps prior to loosening other camshaft journal cap bolts. Damage to the camshaft journal thrust cap can occur if not removed first.**

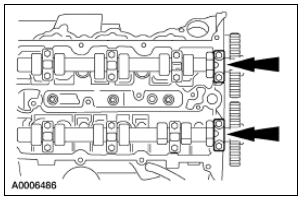
   ⚠ CAUTION: Cylinder head camshaft journal caps and cylinder heads are numbered for assembly in their original positions. Keep camshaft journal caps with the cylinder head from which they were removed. Do not mix with camshaft journal caps from another cylinder head.

   Remove the bolts.

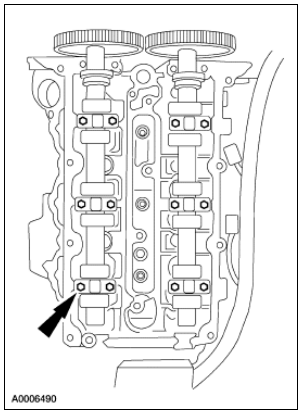


3. **NOTE:** The camshaft journal thrust caps have alignment dowels.

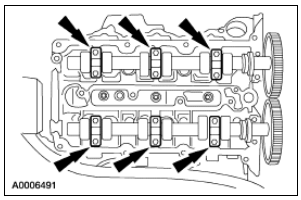
   Using a soft-faced mallet, gently loosen and remove the camshaft journal thrust caps.



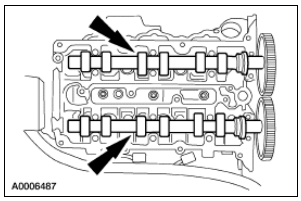
4. Remove the remaining camshaft journal cap bolts.



5. Using a soft-faced mallet, gently loosen and remove the remaining camshaft journal caps.



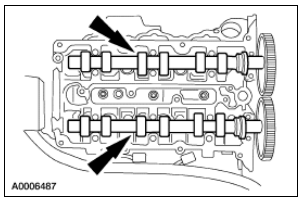
6. Carefully lift out the camshafts.



Installation

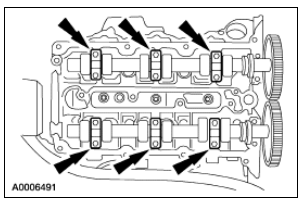
1. **NOTE:** Be sure camshaft bearing caps are installed in their original positions.

   Lubricate camshafts with clean engine oil and carefully position the camshafts into the cylinder head.

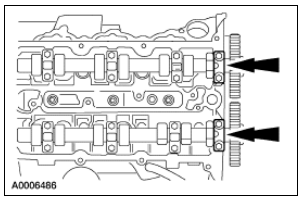


2. ⚠ **CAUTION: Do not install the camshaft journal thrust caps until all of the camshaft bearing caps have been installed, or damage to the thrust caps can occur.**

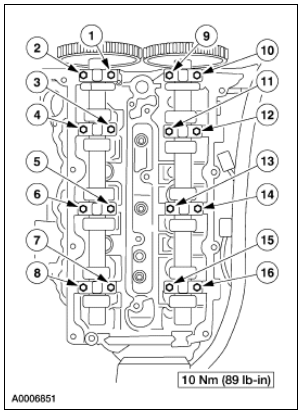
   Lubricate the bearing surfaces of the camshaft bearing caps with clean engine oil, install the bearing caps, and loosely install the bolts.



3. Lubricate the bearing surfaces of the camshaft bearing thrust caps with clean engine oil, install the caps, and loosely install the bolts.



4. Tighten the bolts in sequence shown.



5. **NOTE:** If new camshafts were installed, refer to Valve Spring Lash Adjustment in this section.

   Lubricate the tappet shims and camshaft lobes with clean engine oil.

6. ⚠ **CAUTION: Verify that the crankshaft is in the nine o'clock position before rotating the camshafts, or damage to the valve train can result.**

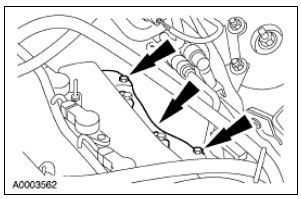
   Rotate the camshafts to be make sure they are not binding. If binding occurs, check to sure that all bearing caps are in their original positions. Loosen all bearing cap bolts in reverse order and retighten.

7. Install the timing chains. For additional information, refer to Timing Drive Components in this section.

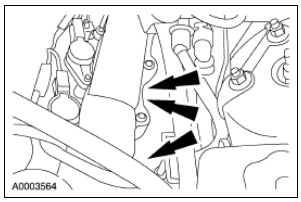
Exhaust Manifold LH

Removal

1. If equipped, remove the heat shield.

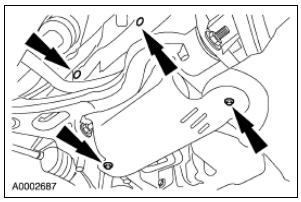


2. Remove the three upper nuts on the LH exhaust manifold.

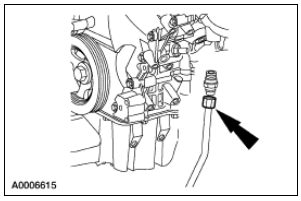


3. Remove the three-way catalytic converter (TWC). For additional information, refer to Section 309-00 .

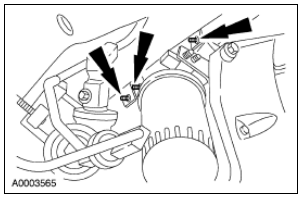
4. Remove the lower splash shield.
   - Remove the bolts.
   - Remove the pin-type retainers and the shield.



5. If equipped, remove the secondary air tube from the exhaust manifold.



6. Remove the three lower nuts and the exhaust manifold.
   - Discard the gasket.

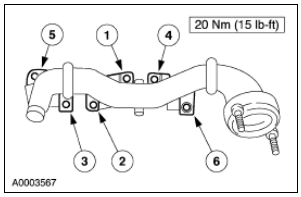


Installation

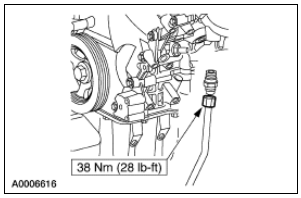
1. **NOTE:** To make sure of a seal, the manifold bolts must be tightened to the same specification two times.

   Using a new gasket, install the exhaust manifold. Tighten the nuts in two stages.

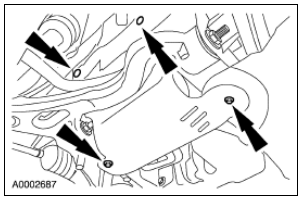
   - Stage 1: Tighten to 20 Nm (15 lb-ft).
   - Stage 2: Tighten to 20 Nm (15 lb-ft).



2. If equipped, install the secondary air tube to the exhaust manifold.

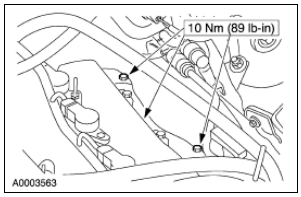


3. Install the lower splash shield.
   - Install the shield and the pin-type retainers.
   - Install the bolts.



4. Install the TWC. For additional information, refer to Section 309-00 .

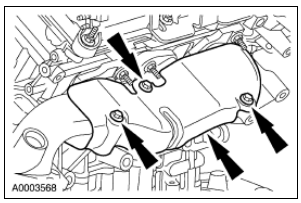
5. If equipped, install the heat shield.



Exhaust Manifold RH

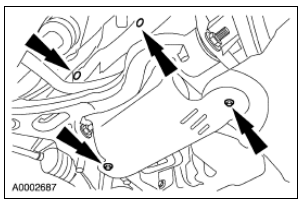
Removal

1. If equipped, remove the heat shield.



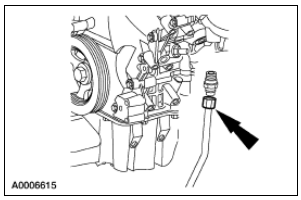
2. Remove the three-way catalytic converter (TWC). For additional information, refer to Section 309-00 .

3. Remove the lower splash shield.
   - Remove the bolts.
   - Remove the pin-type retainers and the shield.

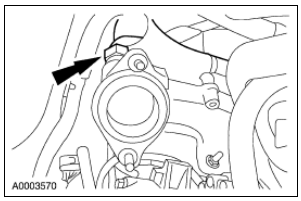


4. **NOTE:** Left side shown; right side similar.

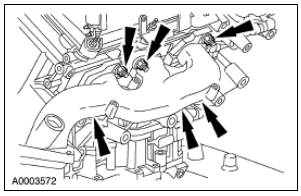
   If equipped, remove the secondary air tube from the exhaust manifold.



5. Disconnect the EGR valve to exhaust manifold tube.



6. Remove the six nuts and the exhaust manifold.
   - Discard the gasket.

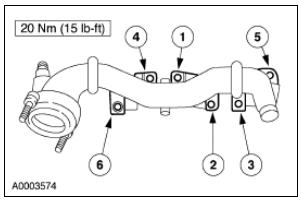


Installation

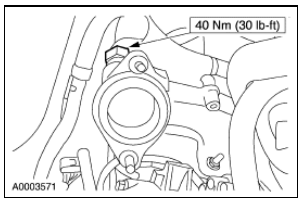
1. **NOTE:** To verify the seal, the manifold bolts must be tightened to the same specification two times.

   Using a new gasket, install the exhaust manifold. Tighten the nuts in two stages:

   - Stage 1: Tighten to 20 Nm (15 lb-ft).
   - Stage 2: Tighten to 20 Nm (15 lb-ft).

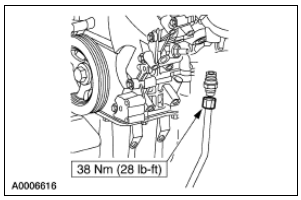


2. Install the EGR valve-to-exhaust manifold tube.

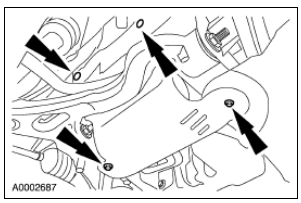


3. **NOTE:** Left side shown; right side similar.

   If equipped, install the secondary air tube to the exhaust manifold.

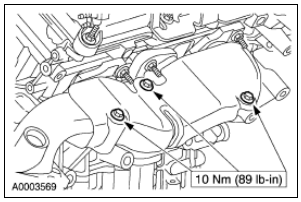


4. Install the lower splash shield.
   - Install the shield and the pin-type retainers.
   - Install the bolts.



5. Install the TWC. For additional information, refer to Section 309-00 .

6. If equipped, install the heat shield.


A0003569
10 Nm (89 lb-in)

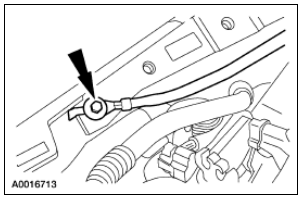
Cylinder Head LH

Material

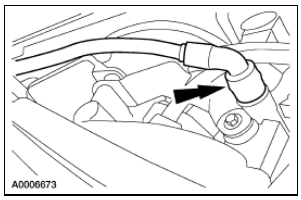
Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

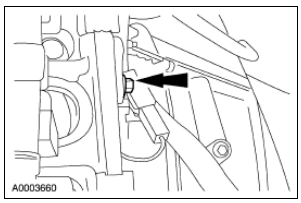
1. Remove the LH camshafts. For additional information, refer to Camshafts LH in this section.
2. Remove the LH exhaust manifold. For additional information, refer to Exhaust Manifold LH in this section.
3. Remove the lower intake manifold. For additional information, refer to Lower Intake Manifold .
4. Remove the ground strap.



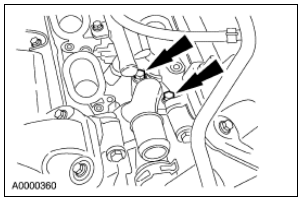
5. Disconnect the PCV tube.



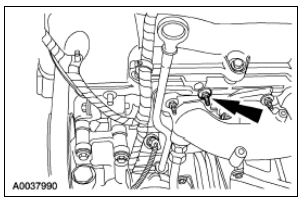
6. Remove the noise suppressor bolt.



7. Remove the bolts and the coolant outlet tube.

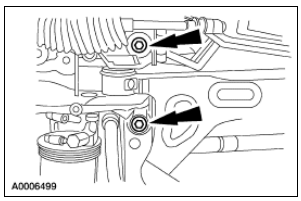


8. Remove the oil level indicator tube stud bolt.



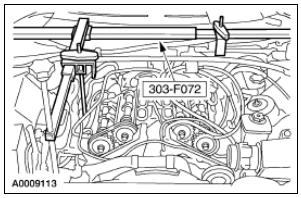
9. Raise the vehicle.

10. Install the four crossmember bolts.

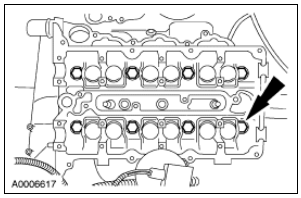


11. Lower the vehicle.

12. Remove the special tool.



13. Remove the bolts and the LH cylinder head.
    - Discard the gasket.



Installation

1. **⚠ CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

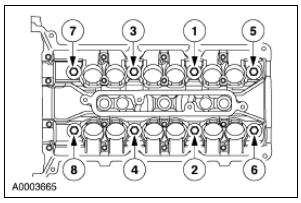
   ⚠ CAUTION: New cylinder head bolts must be installed. They are tighten-to-yield design and cannot be reused.

   NOTE: LH and RH cylinder head gaskets are not interchangeable.

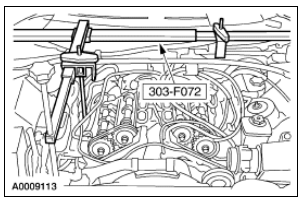
   Using a new cylinder head gasket and bolts, install the LH cylinder head and loosely install the bolts.

2. Tighten the bolts in six stages in the sequence shown.
   - Stage 1: Tighten to 30 Nm (22 lb-ft).
   - Stage 2: Rotate 90 degrees.

- Stage 3: Back out a minimum of one full turn (360 degrees).
- Stage 4: Tighten to 30 Nm (22 lb-ft).
- Stage 5: Rotate 90 degrees.
- Stage 6: Rotate all bolts an additional 90 degrees.

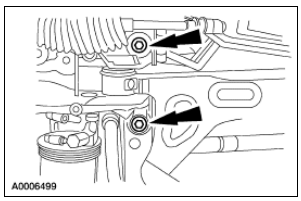


3. Install the special tool.



4. Raise the vehicle.

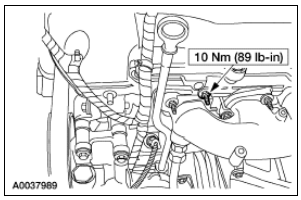
5. Remove the four crossmember bolts.



6. Lower the vehicle.

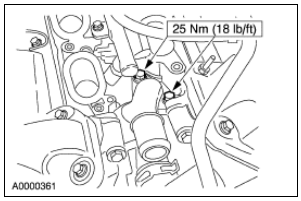
7. **NOTE:** Lubricate the O-ring seal with clean engine oil before installing.

   Install the oil level indicator tube stud bolt.

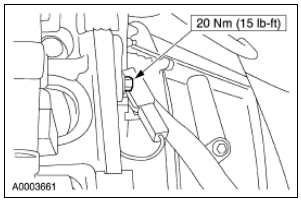


8. **NOTE:** Clean the sealing surfaces and inspect the O-ring seals thoroughly.

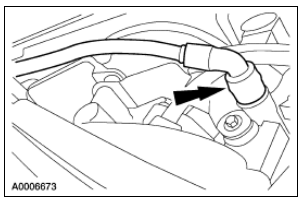
   Install the coolant outlet tube and the retaining bolts.



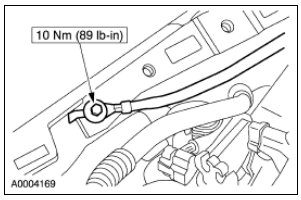
9. Position the noise suppressor and install the bolt.



10. Connect the PCV tube.



11. Install the ground strap.



12. Install the lower intake manifold. For additional information, refer to Lower Intake Manifold in this section.

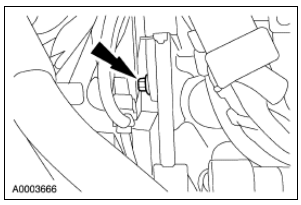
13. Install the LH exhaust manifold. For additional information, refer to Exhaust Manifold LH in this section.

14. Install the LH camshafts. For additional information, refer to Camshafts LH in this section.

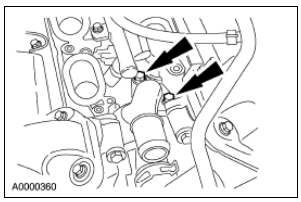
Cylinder Head RH

Removal

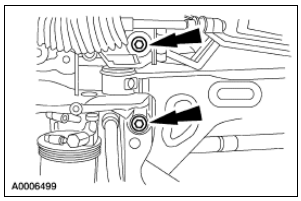
1. Remove the RH camshafts. For additional information, refer to Camshafts RH in this section.
2. Remove the RH exhaust manifold. For additional information, refer to Exhaust Manifold RH in this section.
3. Remove the lower intake manifold. For additional information, refer to Lower Intake Manifold in this section.
4. Remove the noise suppressor bolt.



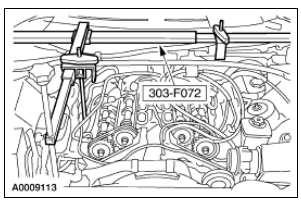
5. Remove the bolts and the coolant outlet tube.



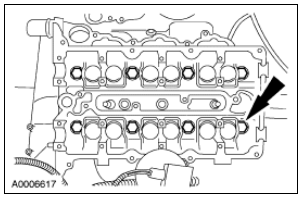
6. Raise the vehicle.
7. Install the four crossmember bolts.



8. Lower the vehicle.
9. Remove the special tool.



10. Remove the bolts and the RH cylinder head.
    - Discard the gasket.



Installation

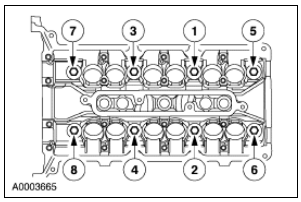
1. **⚠ CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tool cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.**

   ⚠ CAUTION: The cylinder head bolts must be replaced with new bolts. They are tighten-to-yield designed and cannot be reused.

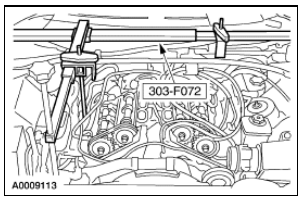
   NOTE: LH and RH cylinder head gaskets are not interchangeable.

   Using a new cylinder head gasket and bolts, install the RH cylinder head and loosely install the bolts.

2. Tighten the bolts in six stages in the sequence shown.
   - Stage 1: Tighten to 30 Nm (22 lb-ft).
   - Stage 2: Rotate 90 degrees.
   - Stage 3: Back out a minimum of one full turn (360 degrees).
   - Stage 4: Tighten to 30 Nm (22 lb-ft).
   - Stage 5: Rotate 90 degrees.
   - Stage 6: Rotate all bolts an additional 90 degrees.

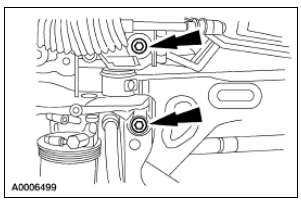


3. Install the special tool.



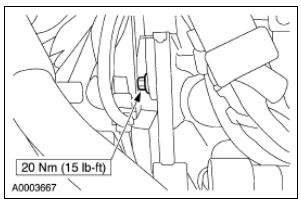
4. Raise the vehicle.

5. Remove the four crossmember bolts.



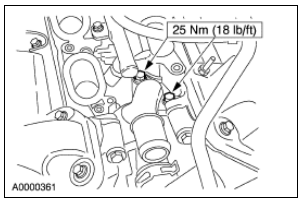
6. Lower the vehicle.

7. Position the noise suppressor and install the bolt.



8. **NOTE:** Clean the sealing surfaces and inspect the O-ring seals thoroughly.

   Position the coolant outlet tube and install the bolts.



9. Install the lower intake manifold. For additional information, refer to Lower Intake Manifold in this section.

10. Install the RH exhaust manifold. For additional information, refer to Exhaust Manifold RH in this section.

11. Install the RH camshafts. For additional information, refer to Camshafts RH in this section.

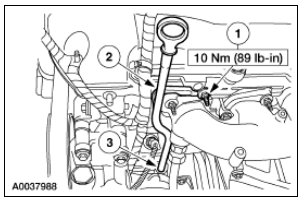
Oil Level Indicator and Tube

Material

Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

1. Remove the oil level indicator and tube.
    1. Remove the stud bolt.
    2. Remove the oil level indicator tube.
    3. Inspect the O-ring seal at the end of the oil level indicator tube and install a new O-ring seal if necessary.



Installation

1. **NOTE:** Lubricate the O-ring with clean engine oil before installing.

   To install, reverse the removal procedure.

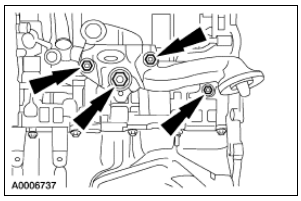
Oil Filter Adapter

Material

Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

1. Remove the LH engine mount. For additional information, refer to Engine Mount - LH in this section.
2. Drain the engine oil.
3. Remove the oil filter.
4. If equipped, remove the oil cooler. For additional information, refer to Oil Cooler in this section.
5. Remove the bolts and the oil filter adapter.



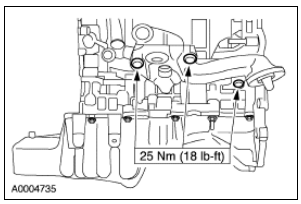
Installation

1. **NOTE:** The oil filter adapter bolts must be tightened in two steps.

   NOTE: Inspect the O-ring seal and the surfaces for contamination prior to installation.

   NOTE: Non-oil cooler equipped engine shown. Engines equipped with oil cooler are similar.

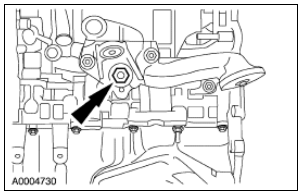
   Position the oil filter adapter and a new O-ring seal and install the bolts.



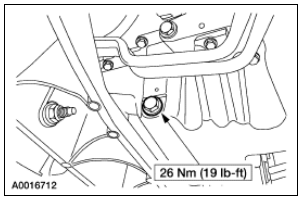
2. **NOTE:** Non-oil cooler equipped engine shown. Engines equipped with oil cooler are similar.

   Using a new O-ring seal, lubricate with clean engine oil and install the bolt.
   Tighten the oil filter adapter bolts in two stages:

   - Stage 1: Tighten to 30 Nm (22 lb-ft).
   - Stage 2: Tighten to 155 Nm (114 lb-ft).



3. Tighten the oil pan drain plug.



4. Install the oil filter.

5. If equipped, install the oil cooler. For additional information, refer to Oil Cooler in this section.

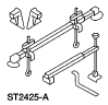
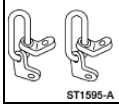
6. Fill the engine with clean engine oil.

7. Install the LH engine mount. For additional information, refer to Engine Mount - LH in this section.

8. If drained, fill the engine cooling system. For additional information, refer to Section 303-03 .

Oil Pan

Special Tool(s)

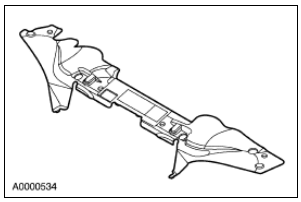
 ST2425-A	Three Bar Engine Support Kit 303-F072
 ST1595-A	Lifting Brackets, Engine 303-050 (T70P-6000)

Material

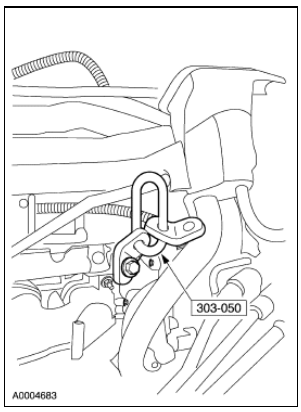
Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4

Removal

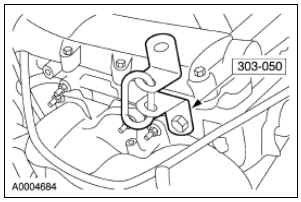
1. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
2. Remove the upper radiator sight shield.



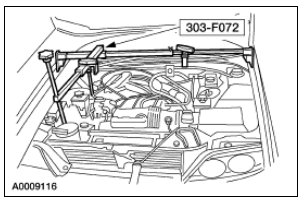
3. Install the special tool.



4. Install the special tool.

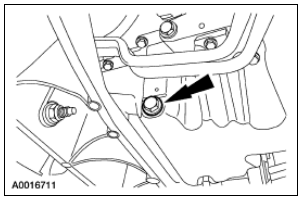


5. Using the special tool, support the engine.

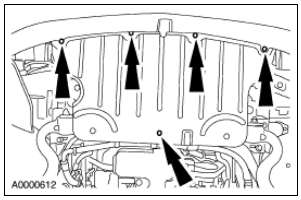


6. Remove the generator. For additional information, refer to Section 414-02 .

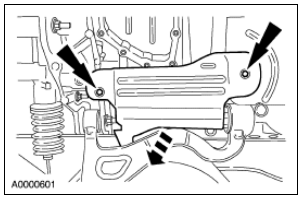
7. Drain the engine oil.



8. Remove the front center splash shield.

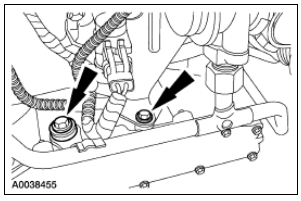


9. Remove the RH front splash shield.



10. Remove the A/C compressor. For additional information, refer to Section 412-03 .

11. If equipped, remove the electronic thermactor air (ETA) bracket bolts.

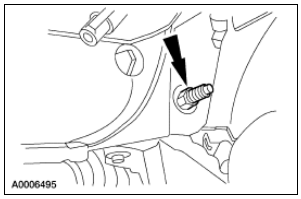


12. **NOTE:** On RH drive vehicles, the power steering hose attaches to the oil pan stud.

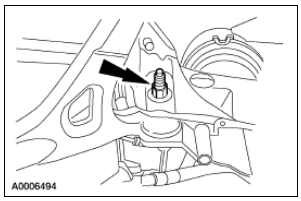
NOTE: On RH drive vehicles, the wiring harness attaches to the RH side of the oil pan.

Remove the steering gear. For additional information, refer to Section 211-02 .

13. Remove the LH lower control arm through bolt.

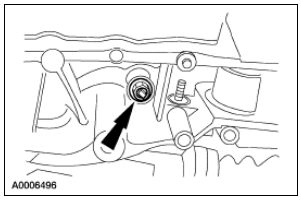


14. Remove the RH lower control arm through bolt.

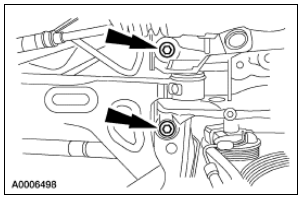


15. **NOTE:** LH shown; RH similar.

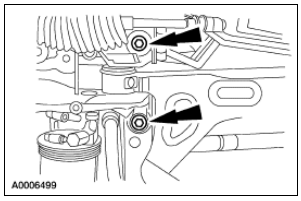
Remove the LH and the RH engine mount nuts.



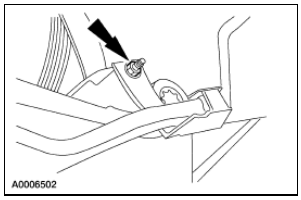
16. Remove the LH subframe bolts.



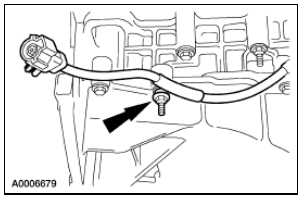
17. Remove the RH subframe bolts.



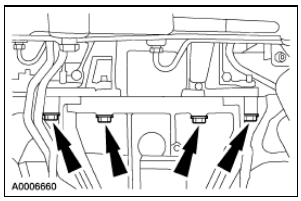
18. Remove the transmission cooler tube bracket nut.



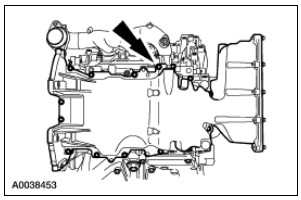
19. Remove the nut and the wiring harness from the stud.



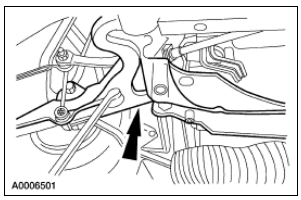
20. Remove the transmission-to-oil pan bolts.



21. Remove the oil pan bolts.



22. Gently pry the subframe down and remove the oil pan.
    - Discard the gasket.



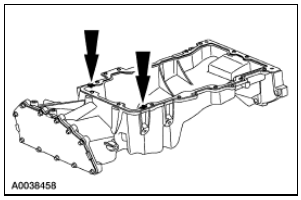
Installation

1. Clean all of the sealing surfaces.

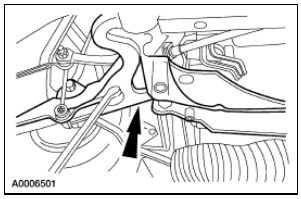
2. Position a new gasket on the pan.

3. ⚠ **CAUTION: The oil pan must be installed and the bolts tightened within four minutes of the sealant application.**

   Apply a 10 mm (0.40 in) dot of Silicone Gasket and Sealant to the oil pan gasket in the indicated position.



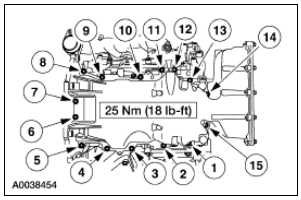
4. Gently pry the subframe down and install the oil pan.



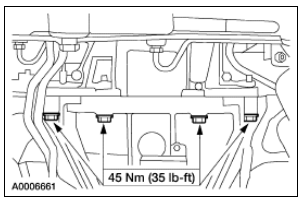
5. **NOTE:** Fasteners No. 4 and No. 9 are studs.

   Position the oil pan and install the studs and bolts.

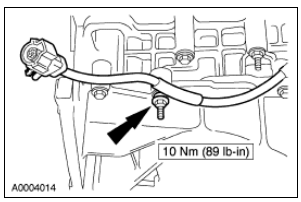
   - Tighten the bolts in the sequence shown.



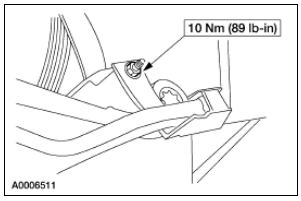
6. Install the transmission-to-oil pan bolts.



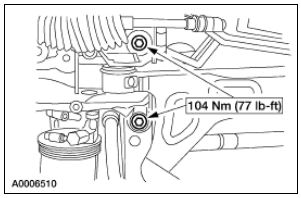
7. Position the wiring harness on the stud and install the nut.



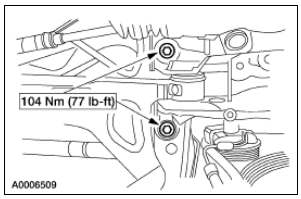
8. Install the transmission cooler tube bracket nut.



9. Install the RH subframe bolts.

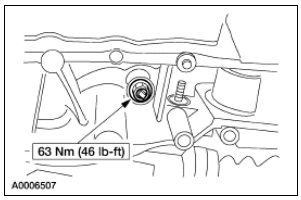


10. Install the LH subframe bolts.

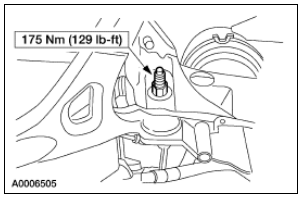


11. **NOTE:** LH shown; RH similar.

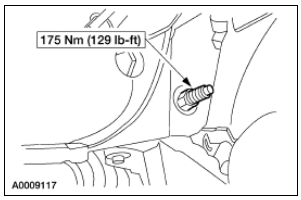
    Install the LH and the RH engine mount nuts.



12. Install the RH lower control arm through bolt.

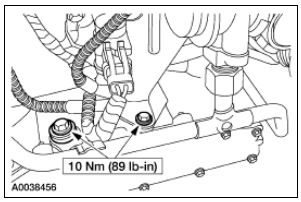


13. Install the LH lower control arm through bolt.



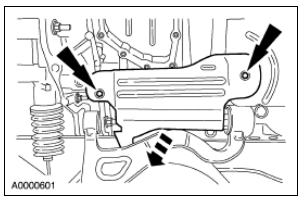
14. Install the steering gear. For additional information, refer to Section 211-02 .

15. If equipped, install the electronic thermactor air (ETA) bracket bolts.

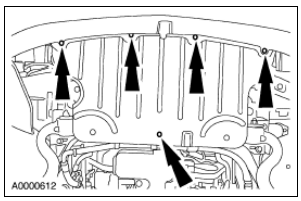


16. Install the A/C compressor. For additional information, refer to Section 412-03 .

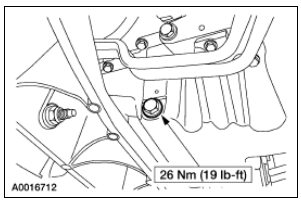
17. Install the RH front splash shield.



18. Install the front center splash shield.

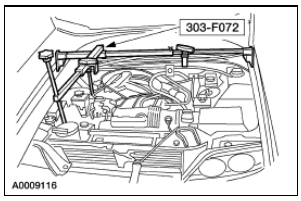


19. Tighten the oil pan drain plug.

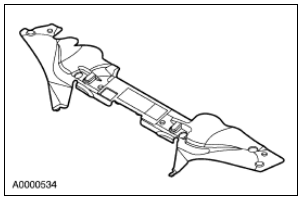


20. Install the generator. For additional information, refer to Section 414-02 .

21. Remove all of the special tools.



22. Install the upper radiator sight shield.



23. Install the air cleaner outlet tube. For additional information, refer to Section 303-12 .

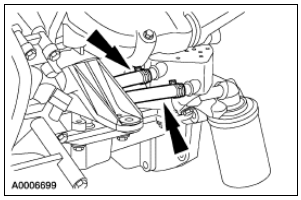
24. Fill the engine crankcase with clean engine oil.

25. Check the vehicle alignment. For additional information, refer to Section 204-00 .

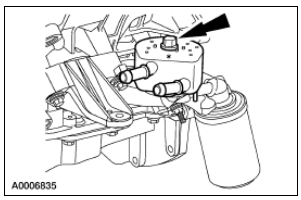
Oil Cooler

Removal

1. Drain the engine cooling system. For additional information refer to Section 303-03 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Remove the oil cooler hoses.



4. Remove the bolt and the oil cooler.
   - Inspect the gasket. Discard if damaged.

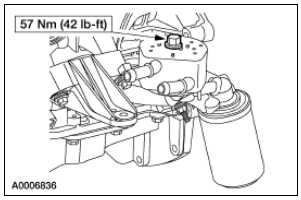


Installation

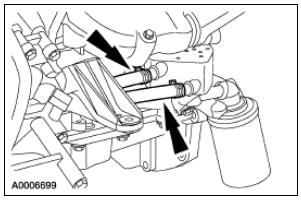
1. **NOTE:** Inspect gasket and surfaces for contamination prior to installation.

   Position the oil cooler and gasket and install the bolt.

   - Rotate the cooler clockwise until the locating pin hits the stop.



2. Install the oil cooler hoses.

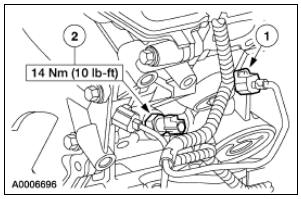


3. Lower the vehicle.
4. Fill the engine cooling system. For additional information, refer to Section 303-03 .

Oil Pressure Switch Oil Cooler

Removal and Installation

1. Remove the oil pressure switch.
    1. Disconnect the electrical connector.
    2. Remove the switch.



2. To install, reverse the removal procedure.

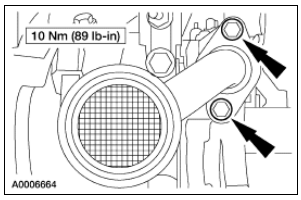
Oil Pump

Removal and Installation

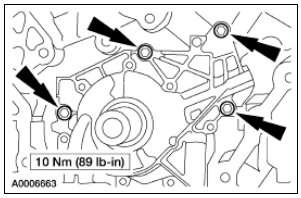
1. Remove the timing chains. For additional information, refer to Timing Drive Components in this section.

2. Remove the crankshaft sprocket.

3. Remove the bolts and the oil pump screen tube.
   - Inspect the O-ring seal. Install a new seal if necessary.



4. Remove the bolts and the oil pump.



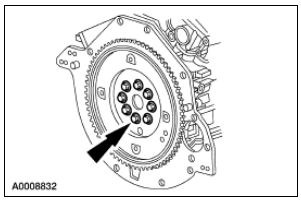
5. To install, reverse the removal procedure.

Flexplate

Removal

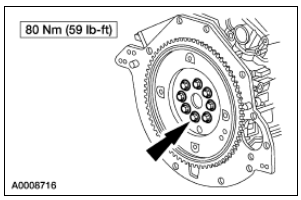
1. Remove the transmission. For additional information, refer to Section 307-01 .

2. Remove the bolts and the flexplate.
   - Inspect the flexplate for cracks or other damage. Install a new flexplate if necessary.



Installation

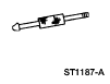
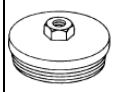
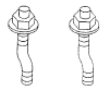
1. Position the flexplate and install the bolts.



2. Install the transmission. For additional information, refer to Section 307-01 .

Crankshaft Rear Oil Seal

Special Tool(s)

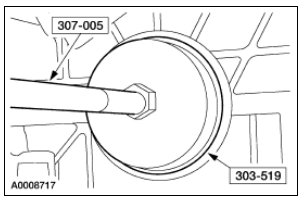
 ST1187-A	Slide Hammer 307-005 (T59L-100-B)
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1333-A	Installer Bolts, Crankshaft Rear Main Oil Seal 303-384 (T91P-6701-A)
 ST1327-A	Installer, Crankshaft Rear Main Oil Seal 303-178 (T82L-6701-A)

Material

Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

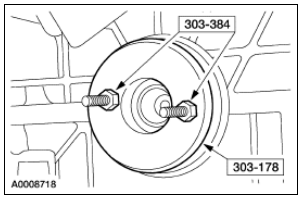
Removal

1. Remove the flywheel. For additional information, refer to Flywheel in this section.
2. Using the special tools, remove the crankshaft rear oil seal.



Installation

1. Lubricate the outer lips and the inner seal on the crankshaft rear oil seal with clean engine oil.
2. Using the special tools, install the crankshaft rear oil seal.

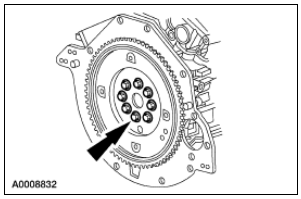


3. Install the flywheel. For additional information, refer to Flywheel in this section.

Flywheel

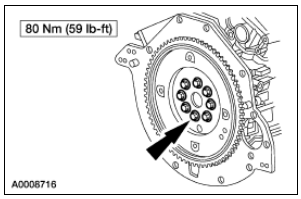
Removal

1. Remove the clutch. For additional information, refer to Section 308-02 .
2. Remove the bolts and the flywheel.



Installation

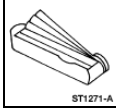
1. Position the flywheel and install the bolts.



2. Install the clutch. For additional information, refer to Section 308-02 .

Valve Spring Lash Adjustment

Special Tool(s)

 ST2429-A	Lift Tool, Camshaft 303-659
 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201A)

Material

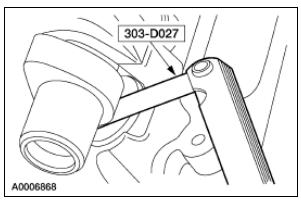
Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP	WSS-M2C153-H

Removal

1. Remove the RH valve cover. For additional information, refer to Valve Cover RH in this section.
2. Remove the LH valve cover. For additional information, refer to Valve Cover LH in this section.
3. **⚠ CAUTION: Rotating the crankshaft in a counterclockwise direction can cause engine damage. Crankshaft journals are directionally machined. Rotating the crankshaft counterclockwise can raise burrs on bearing surfaces, reducing engine life.**

   ⚠ CAUTION: Camshaft lobes must be 180 degrees away from each valve tappet or valve lash measurements will be incorrect.

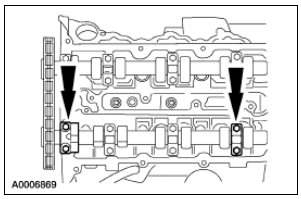
   Rotate the engine clockwise to position the camshaft lobe away from the shim surface.
4. Using the special tool, measure the clearance between the camshaft and the shim surface. Record the information.



5. Use a bright colored marker to mark the position of the timing chain in relation to the camshaft sprockets to make sure that the timing remains correct.
6. **⚠ CAUTION: The camshaft caps must be installed in their original positions.**

   Mark the camshaft cap locations.

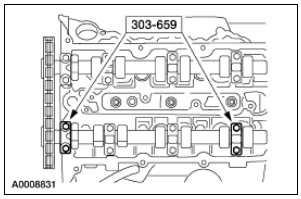
7. Remove the camshaft thrust cap and rear camshaft cap from the camshaft that requires shim adjustment.



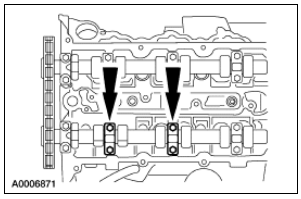
8. **NOTE:** The taller special tool is installed in place of the rear camshaft cap to allow the camshaft to be lifted to remove the shims.

   Install the special tools.

   - Hand-tighten the bolts.



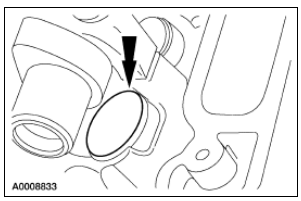
9. Remove the bolts and the center camshaft caps.



10. ⚠ **CAUTION: Do not use any means of marking the shims other than a permanent type marker. Any scratches or paint on the shims can result in incorrect lash adjustments and severe engine damage.**

    Use a permanent marker to mark the location of each shim.

11. Use a rubber-tipped air gun and compressed air to remove the shims that require adjustment.
    - Blow compressed air between the shim edge and bucket rail to dislodge the shim.

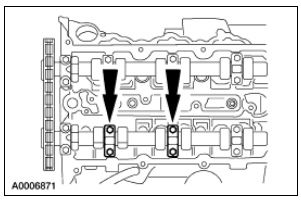


12. Measure and record the thickness of each shim to correspond with valve clearance.

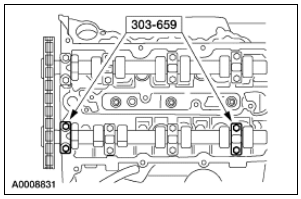
13. Use the following formula to calculate the required shim thickness.
    - Valve clearance specification:
      - ♦ Intake: 0.175 mm - 0.225 mm (0.0069 in - 0.0089 in)
      - ♦ Exhaust: 0.325 mm - 0.375 mm (0.0128 in - 0.0148 in)
    - Original shim thickness + measured clearance - desired clearance = required shim thickness.

Installation

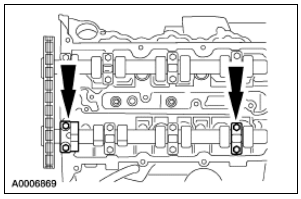
1. Apply a light coat of clean engine oil to the replacement shim(s) and install the shim(s).
2. Apply clean engine oil to the camshaft journals and bearing caps.
3. Position the center camshaft journal caps and loosely install the bolts.



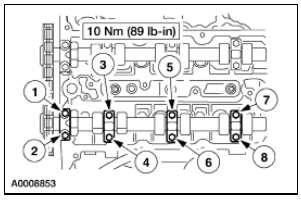
4. Remove the bolts and the special tools.



5. Position the camshaft journal rear and front thrust caps and loosely install the bolts.



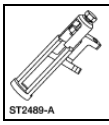
6. Tighten the bolts in the indicated sequence shown.



7. Rotate the crankshaft clockwise to rotate the camshafts two full revolutions and recheck the valve clearance.
8. Install the LH valve cover. For additional information, refer to Valve Cover LH in this section.
9. Install the RH valve cover. For additional information, refer to Valve Cover RH in this section.

Valve Spring Springs, Retainers, and Stem Seals

Special Tool(s)

 ST2489-A	Compressor, Valve Spring 303-648

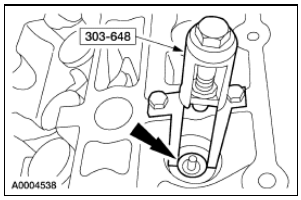
Removal

1. Remove the appropriate camshafts. For additional information, refer to Camshafts LH or Camshafts RH in this section.
2. Position the piston to the top of its stroke on the appropriate cylinder.
3. Remove the appropriate spark plug. For additional information, refer to Section 303-07A .
4. Pressurize the cylinder with compressed air to hold both valves closed.
5. **⚠ CAUTION: Do not use any means of marking the shims other than a permanent type marker. Any scratches or paint on the shims may result in incorrect lash adjustments and severe engine damage.**

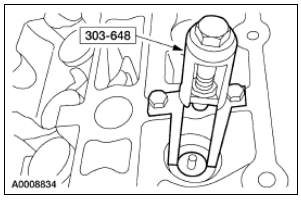
   ⚠ CAUTION: The tappets and shims must be installed in their original positions to make sure of correct valve lash settings.

   Remove the tappet and shim from the valve.

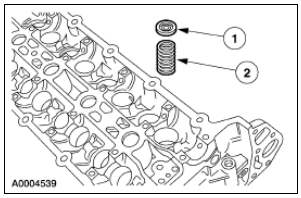
   - If more than one tappet and shim are removed, mark them using a permanent type marker.
6. Using the special tool, compress the valve spring and remove the retainer locks.



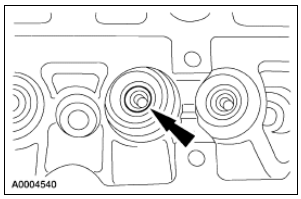
7. Remove the special tool.



8. Remove the valve spring.
   1. Remove the retainer.
   2. Remove the valve spring.



9. Remove the valve stem seal.

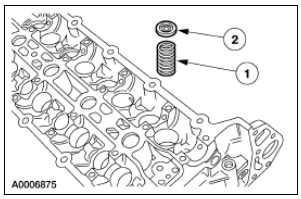


10. Repeat the procedure until all the valve stem seals have been removed.

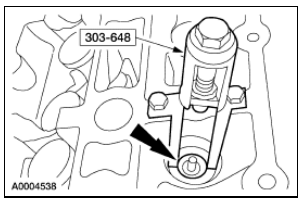
Installation

1. Install the valve stem seal.

2. Install the valve spring.
    1. Install the spring.
    2. Install the retainer.



3. Using the special tool, compress the valve spring and install the retainer locks.



4. Release the compressed air used to hold the valves closed.

5. Install the spark plug. For additional information, refer to Section 303-07A .

6. Repeat the procedure until all of the valve stem seals have been installed.

7. ⚠ **CAUTION: The tappets and shims must be installed in their original positions to make sure of correct valve lash settings.**

   Install the tappet and shim from the valve.

8. Install the camshafts. For additional information, refer to Camshafts LH or Camshafts RH in this section.

Valve Tappet

Removal and Installation

1. Remove the appropriate camshafts. For additional information, refer to Camshafts LH or Camshafts RH in this section.

2. **⚠ CAUTION: Do not use any means of marking the shims other than a permanent type marker. Any scratches or paint on the shims may result in incorrect lash adjustments and severe engine damage.**

   ⚠ CAUTION: The tappets and shims must be installed in their original positions to make sure of correct valve lash settings.

   NOTE: The shim sits on top of the valve tappet.

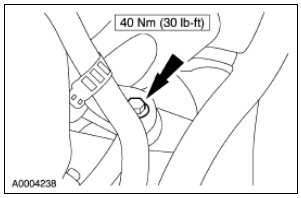
   Remove the tappet and shim.

3. To install, reverse the removal procedure.

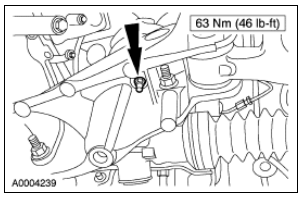
Engine Mount LH

Removal and Installation

1. Remove the intake manifold tuning valve. For additional information, refer to Section 303-14 .
2. Remove the fresh air intake housing. For additional information, refer to Section 412-01 .
3. Remove the LH engine mount upper nut.

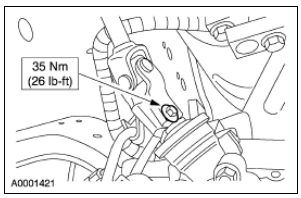


4. Raise and support the vehicle. For additional information, refer to Section 100-02 .
5. Remove the LH engine mount lower nut.

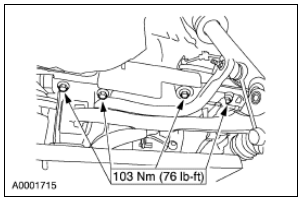


6. ⚠ **CAUTION: The steering wheel must be in the locked position, or the lower end of the column wired in such a way that the steering column does not rotate, resulting in damage to air bag sliding contact.**

   Disconnect the steering coupling.



7. Raise the engine.
8. Loosen the four bolts and lower the sub-frame to remove the mount.

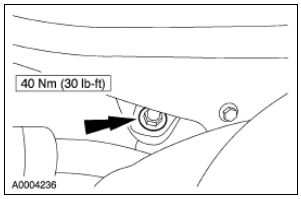


9. To install, reverse the removal procedure.

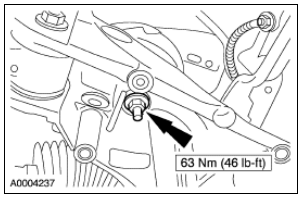
Engine Mount RH

Removal and Installation

1. Remove the intake manifold tuning valve. For additional information, refer to Section 303-14 .
2. Remove the fresh air intake housing. For additional information, refer to Section 412-01 .
3. Remove the RH engine mount upper nut.



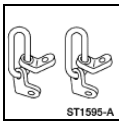
4. Raise and support the vehicle. For additional information, refer to Section 100-02 .
5. Remove the RH engine mount lower nut.



6. Raise the engine and remove the engine mount.
7. To install, reverse the removal procedure.

Engine

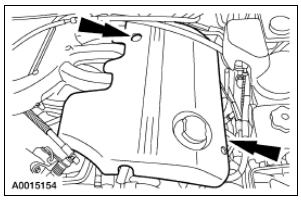
Special Tool(s)

 ST1595-A	Engine Lifting Brackets 303-050

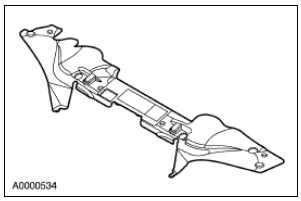
Removal

All vehicles

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the air cleaner outlet tube and the air cleaner. For additional information, refer to Section 303-12 .
3. Remove the engine appearance cover.

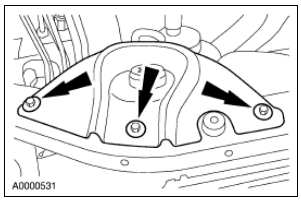

A0015154

4. Drain the cooling system. For additional information, refer to Section 303-03 .
5. Evacuate the A/C system. For additional information, refer to Section 412-00 .
6. Remove the upper radiator sight shield.

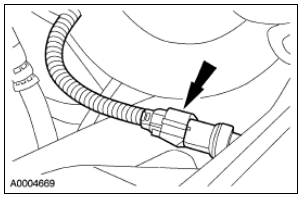

A0000534

7. **NOTE:** RH shown; LH similar.

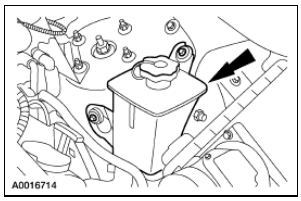
   Remove the upper radiator support brackets.


A0000531

8. Disconnect the A/C pressure switch electrical connector.

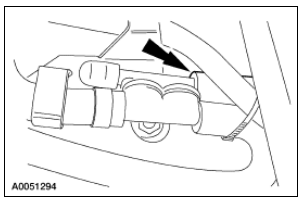


9. Remove the power steering reservoir bolts and secure the power steering reservoir to the engine.

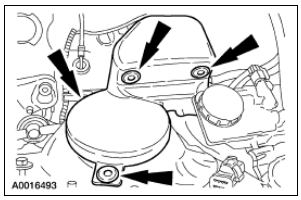


10. Disconnect the fuel tube. For additional information, refer to Section 310-00 .

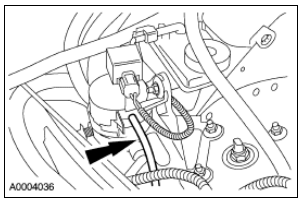
11. Disconnect the brake booster vacuum hose.



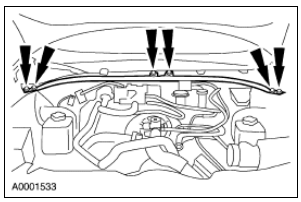
12. Remove the vapor management valve (VMV) cover.



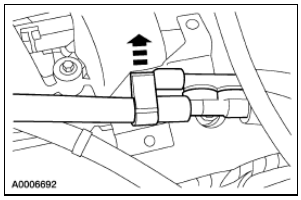
13. Disconnect the vacuum hose.



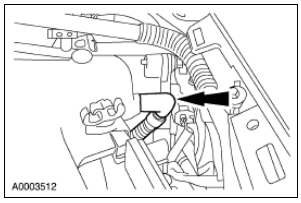
14. Remove the fresh air inlet duct. For additional information, refer to Section 412-01 .



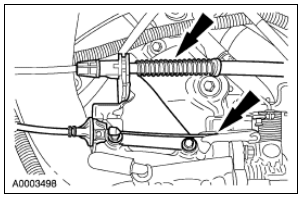
15. Unclip the chassis vacuum tubes from the support bracket and disconnect the tubes.



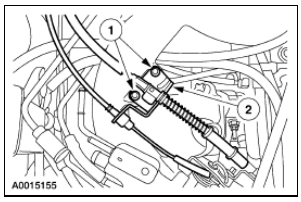
16. Disconnect the main vacuum hose from the rear of the intake manifold.



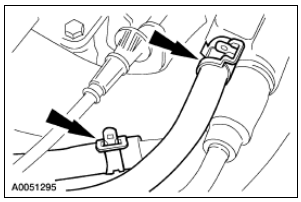
17. Disconnect the accelerator and speed control cables.



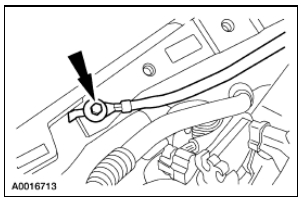
18. Remove the cable brackets.
    1. Remove the bolts.
    2. Remove the bracket.



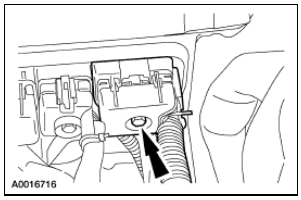
19. Disconnect the throttle body coolant hoses.



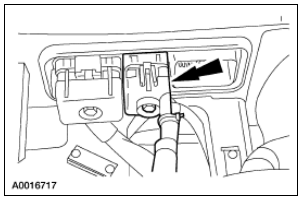
20. Remove the ground strap bolt.



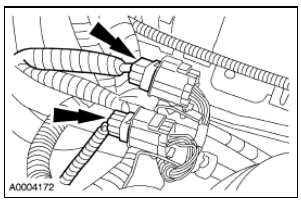
21. Loosen the bolt and disconnect the main engine wiring harness connector.



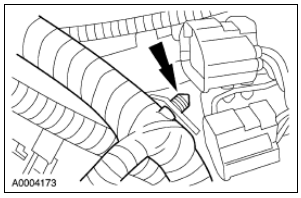
22. Loosen the bolt and disconnect the main transmission wiring harness connector.



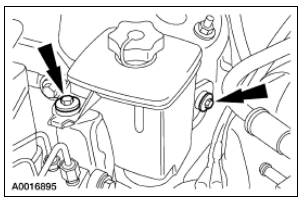
23. Disconnect the two fuel charging wiring harness connectors.



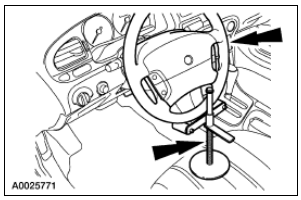
24. Disconnect the wiring harness retainer from the bracket.



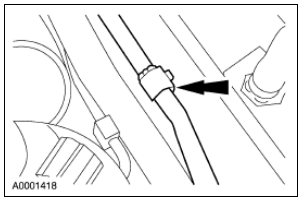
25. Remove the bolts and secure the hydraulic cooling fan reservoir to the engine.



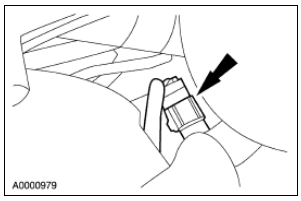
26. Hold the steering wheel in the straight forward position using a suitable holding device.



27. Unclip the tube from the frame.



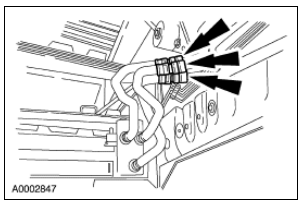
28. Disconnect the connector located at the end of the coolant valve harness pigtail.



29. **NOTE:** The top heater hose has a green identifying mark to match the hose on the dual coolant flow valve. If the mark is not visible, identify the hoses for location. This will aid in the correct installation of the hose assemblies.

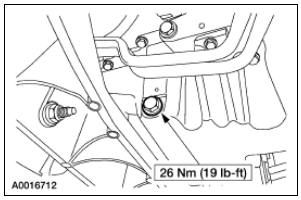
    NOTE: Hose assemblies shown with components removed for clarity.

    Disconnect the three quick-disconnect couplings from the coolant control valve hoses. For additional information, refer to Section 412-00 .



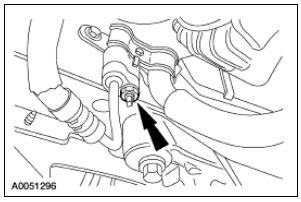
30. Raise and support the vehicle. For additional information, refer to Section 100-02 .

31. Drain the engine oil.

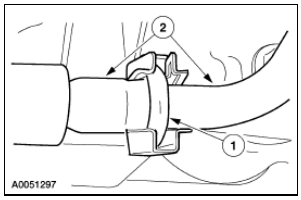


32. Remove the center, LH and RH splash shields.

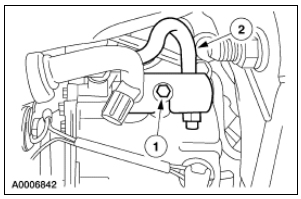
33. Disconnect the A/C high pressure tube at the right frame rail.



34. Disconnect the A/C suction tube.
    1. Remove the safety clip.
    2. Disconnect the A/C tube.



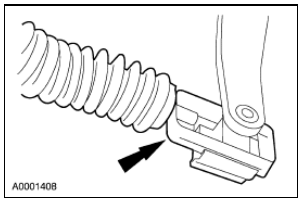
35. Reposition the A/C manifold and tube assembly.
    1. Remove the bolt.
    2. Reposition the A/C manifold and tube assembly.



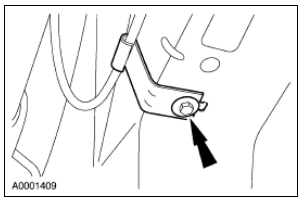
36. Remove the driveshaft. For additional information, refer to Section 205-01 .

Vehicles with automatic transmission

37. Disconnect the shift cable from the transmission.

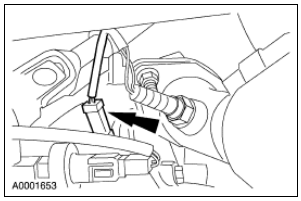


38. Remove the bolt securing the cable bracket to the floor.

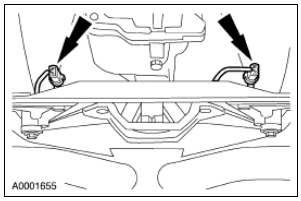


All vehicles

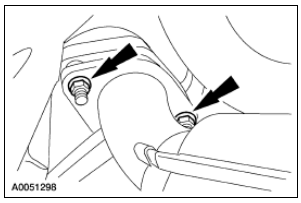
39. Disconnect the two heated oxygen sensors (HO2S) electrical connectors.



40. Disconnect the two catalyst monitor connectors.



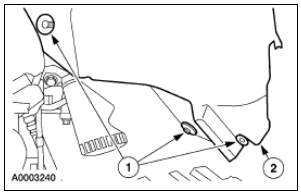
41. Remove the four nuts and the three-way catalytic converter.



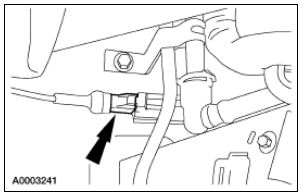
42. Lower the vehicle.

43. Remove the front wheels and tires. For additional information, refer to Section 204-04 .

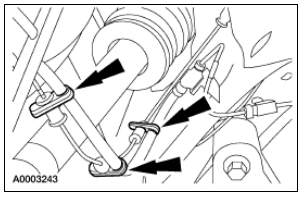
44. Position the inner splash shield aside.
    1. Remove the pin-type retainers.
    2. Position the inner splash shield aside.



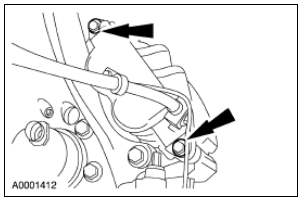
45. Disconnect the anti-lock brake sensor electrical connector.



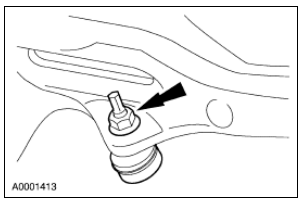
46. Remove the anti-lock brake sensor harness from the brake hose clips.



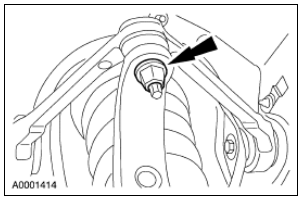
47. Remove the bolts and the front brake calipers. Support the calipers out of the way.



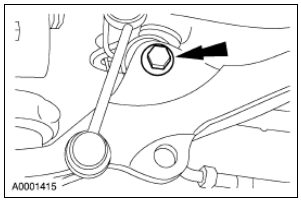
48. Remove the nuts and disconnect the stabilizer links lower mounts.



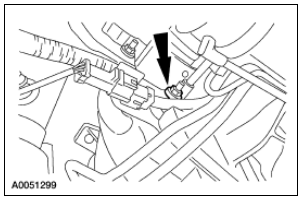
49. Remove the nuts and disconnect the upper ball joints.



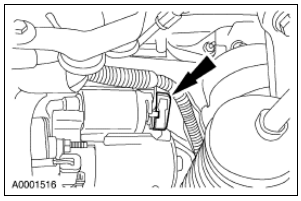
50. Remove the lower strut mount bolts.



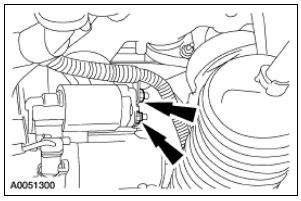
51. Disconnect the ground strap.



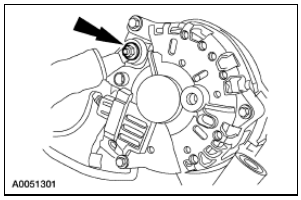
52. Remove the cover.



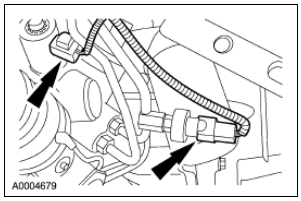
53. Remove the nuts and position the cables aside.



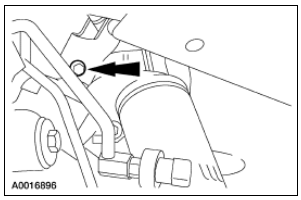
54. Disconnect the B+ terminal from the generator.



55. Disconnect the power steering pressure sensor electrical connectors.

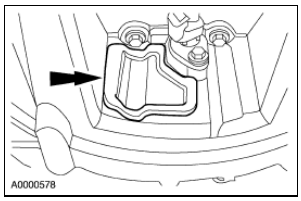


56. Remove the steering shaft clamp bolt.



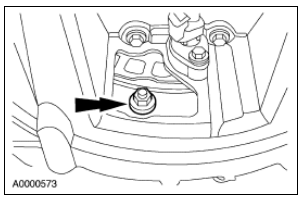
Vehicles with automatic transmission

57. Remove the access cover.



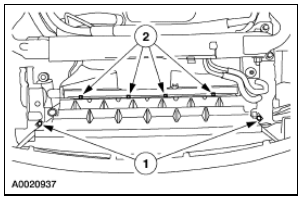
58. **NOTE:** Mark one stud and the flexplate for assembly reference.

    Remove the nuts.

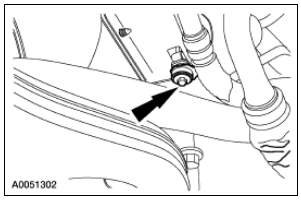


All vehicles

59. Remove the air deflector.
    1. Remove the pin-type retainers.
    2. Remove the side-clip retainers.



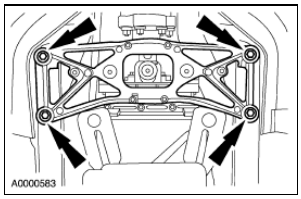
60. Remove the power steering hose bracket bolt.



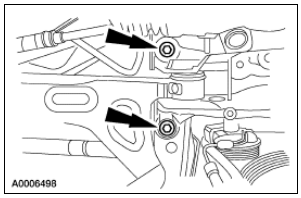
61. Support the rear of the vehicle with suitable safety stands.

62. Support the engine, transmission, front and center crossmembers and the cooling system with a powertrain lift and a transmission support bracket.

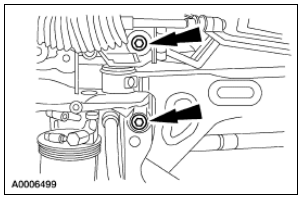
63. Remove the four transmission crossmember bolts.



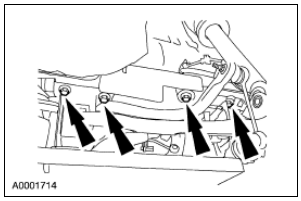
64. Remove the LH subframe bolts.



65. Remove the RH subframe bolts.

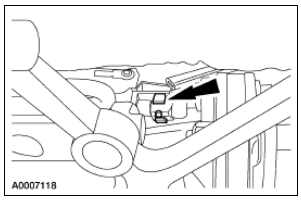


66. Remove the four crossmember bolts.

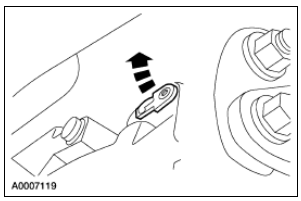


Vehicles with manual transmission

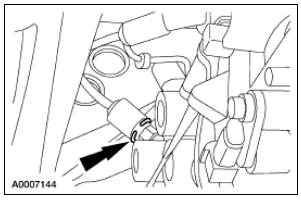
67. Disconnect the selector rod.
    - Remove the selector rod locating pin.



68. Disconnect the stabilizer rod.
    - Remove the stabilizer rod locating pin.

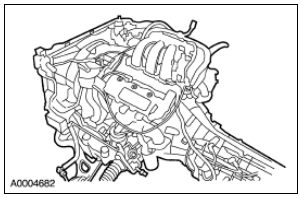


69. Disconnect the slave cylinder supply tube.
    - Remove the slave cylinder supply tube retaining clip.
    - Plug the hose to prevent loss of fluid.

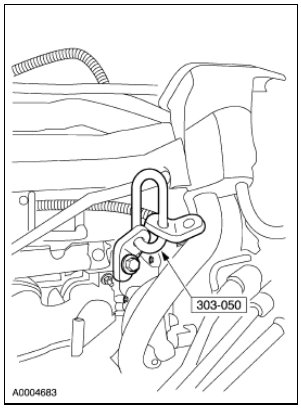


All vehicles

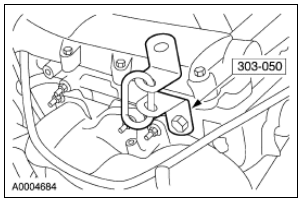
70. Carefully lower the entire assembly from the vehicle.



71. Install the special tool to the engine.

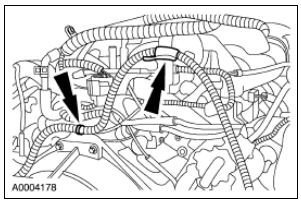


72. Install the special tool to the engine.

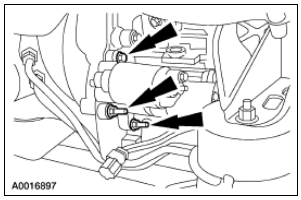


73. Using an engine crane and spreader bar, support the engine and transmission in the front subframe.

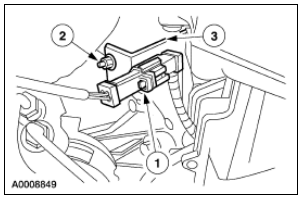
74. Disconnect the two wire harness retainers and position the harness out of the way.



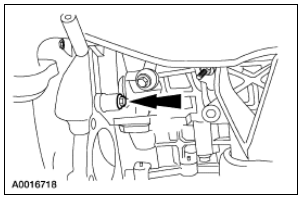
75. Remove the starter assembly.



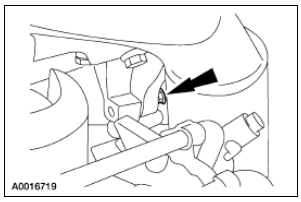
76. Remove the heated oxygen sensor (HO2S) bracket.
    1. Unclip the connector.
    2. Remove the nut.
    3. Remove the bracket.



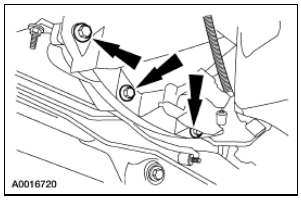
77. Remove the engine to transmission bolt.



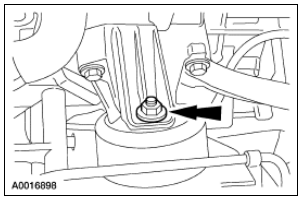
78. Remove the engine to transmission bolt.



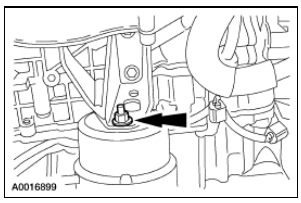
79. Remove the four lower engine to transmission bolts.



80. Remove the LH engine mount nut.

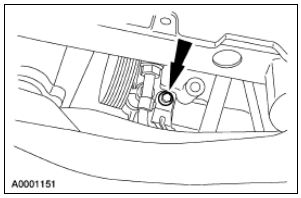


81. Remove the RH engine mount nut.

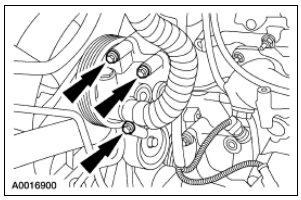


82. Remove the accessory drive belt. For additional information, refer to Section 303-05 .

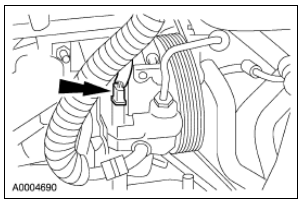
83. Remove the power steering bracket bolt and bracket.



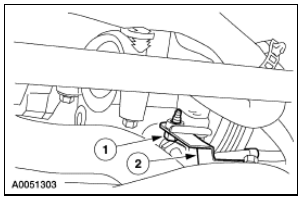
84. Remove the bolts and secure the power steering pump and reservoir aside.



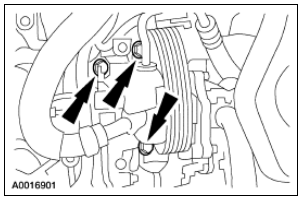
85. Disconnect the hydraulic cooling fan pump electrical connector.



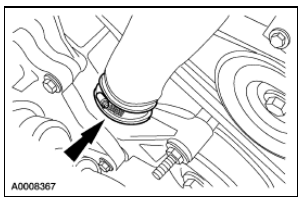
86. Remove the hydraulic cooling fan tube bracket.
    1. Remove the bolt.
    2. Remove the bracket.



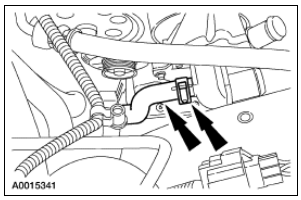
87. Remove the bolts and secure the hydraulic cooling fan pump aside.



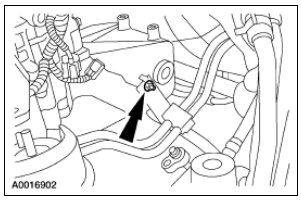
88. Disconnect the upper radiator hose.



89. Disconnect the heater water hose from the water pump.

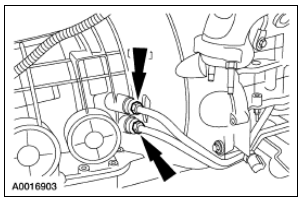


90. If equipped, remove the nut and transmission cooler tubes from the oil pan.

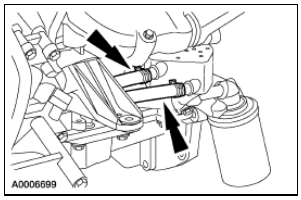


91. Remove the engine and transmission from the subframe. Rest on the floor or on a bench.

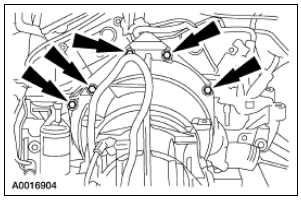
92. If equipped, remove the transmission oil cooler tubes and plug the openings.



93. If equipped, disconnect the oil cooler hoses.

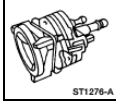


94. Remove the bolts and separate the transmission from the engine.



Engine

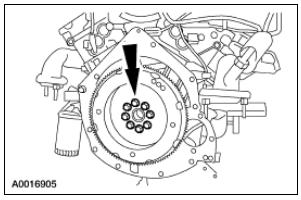
Special Tool(s)

 ST2115-A	Installer, Connecting Rod 303-462 (T94P-6136-AH)
 ST1184-A	3-Jaw Puller 303-D121 or equivalent
 ST1276-A	Cylinder Ridge Reamer 303-016 (T64L-6011-EA)

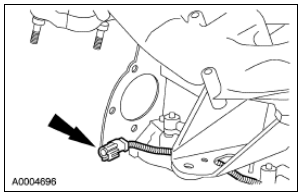
Disassembly

1. **NOTE:** If equipped with manual transmission, remove the clutch assembly. For additional information, refer to Section 308-01 .

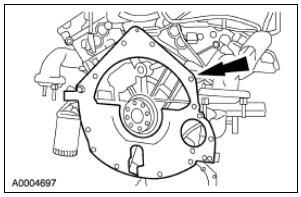
   Remove the bolts and the flywheel.



2. Unclip the LH and RH wiring harness retainers.



3. Remove the rear separator plate assembly.

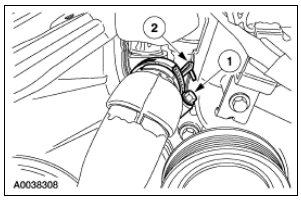


4. Mount the engine on a engine stand.

5. Remove the lifting equipment.

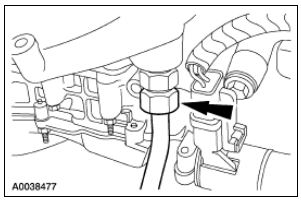
6. Disconnect the water pump hose from the inlet tube.

1. Loosen the screw-type clamp.
2. Compress the constant-tension clamp and remove the water pump hose.

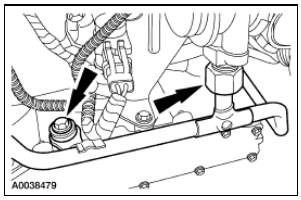


7. **NOTE:** Right side shown, left side similar.

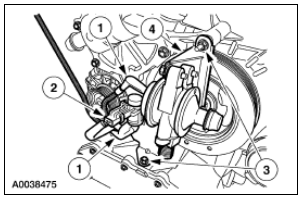
   Disconnect the thermactor tube at the exhaust manifold.



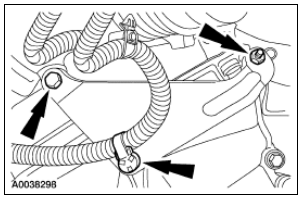
8. Disconnect the thermactor tube at the valve, remove the bolt and remove the thermactor tube.



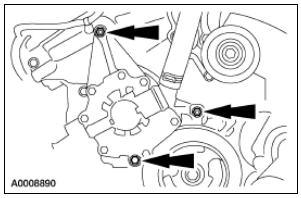
9. If equipped, remove the thermactor air control valve and bracket.
   1. Disconnect the vacuum connectors.
   2. Disconnect the electrical connector.
   3. Remove the bolt and nut.
   4. Remove the valve/bracket.



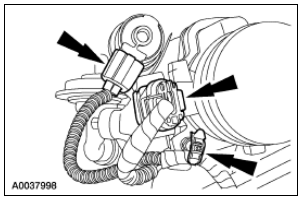
10. Disconnect the wiring retainer. Remove the bolt, nuts and the intake manifold support bracket.



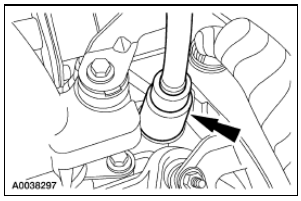
11. Remove one bolt, two stud bolts and the water pump.



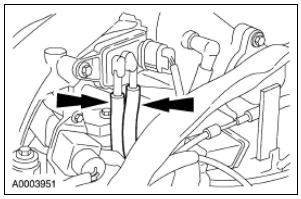
12. Disconnect the throttle position (TP) sensor and idle air control (IAC) electrical connectors. Disconnect the wiring harness retainer.



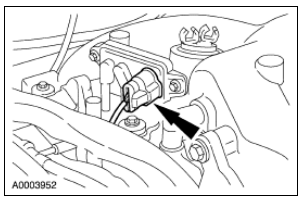
13. Disconnect the positive crankcase ventilation (PCV) tube at the rear of the upper intake manifold.



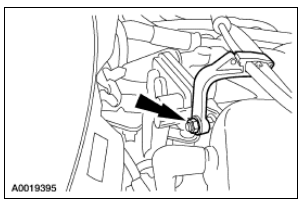
14. Disconnect the differential pressure feedback EGR hoses.



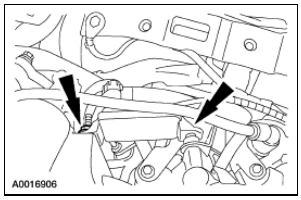
15. Disconnect the differential pressure feedback EGR electrical connector.



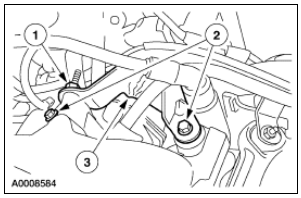
16. Remove the nut and the accelerator cable clip.



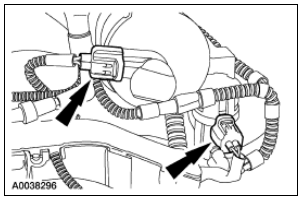
17. Remove the nut and stud and position the differential pressure feedback EGR transducer aside.



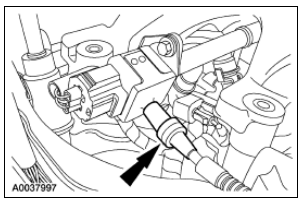
18. Remove the fuel pressure sensor shield.
    1. Remove the nut.
    2. Remove the bolts.
    3. Remove the shield.



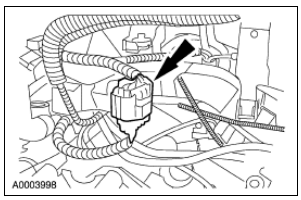
19. Disconnect the EGR vacuum regulator electrical connector and the intake manifold tuning (IMT) valve electrical connector.



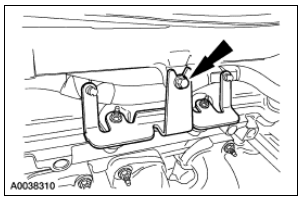
20. Disconnect the fuel pressure sensor jumper from the main vacuum harness.



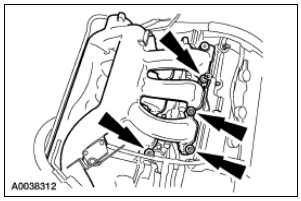
21. Disconnect the fuel injector wiring harness connector.



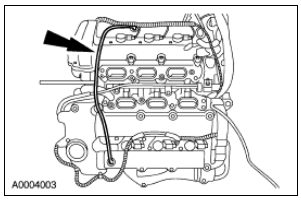
22. Remove the intake manifold bolt.



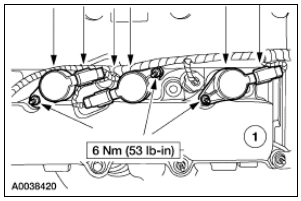
23. Remove the four bolts and the upper intake manifold.



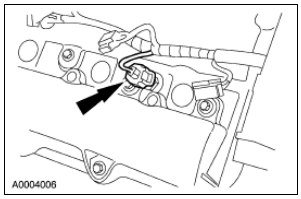
24. Remove the crankcase ventilation tube.



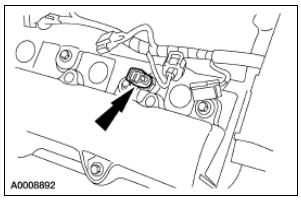
25. Remove the LH ignition coils.
    1. Disconnect the electrical connectors.
    2. Remove the bolts.
    3. Remove the LH ignition coils.



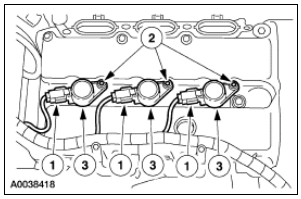
26. Disconnect the cylinder head temperature (CHT) sensor electrical connector.



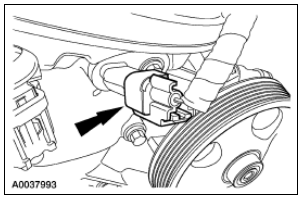
27. Remove the CHT sensor.



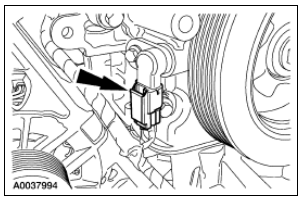
28. Remove the RH ignition coils.
    1. Disconnect the electrical connectors.
    2. Remove the bolts.
    3. Remove the RH ignition coils.



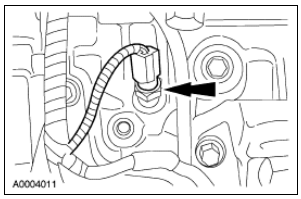
29. Disconnect the camshaft position (CMP) sensor electrical connector.



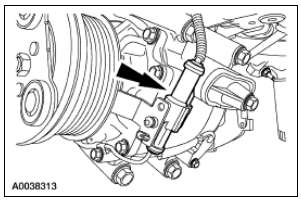
30. Disconnect the crankshaft position (CKP) sensor electrical connector.



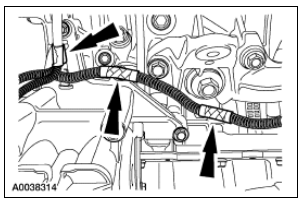
31. Disconnect the oil pressure switch electrical connector.



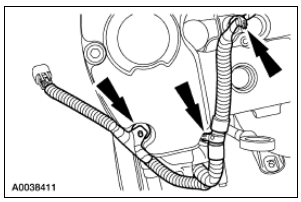
32. Disconnect the A/C electrical connector.



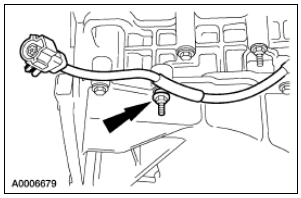
33. Detach the three wiring harness retainers from the block.



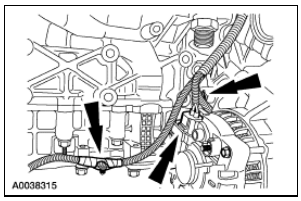
34. Detach the three wiring harness retainers.



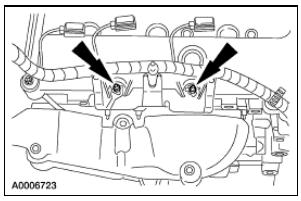
35. Remove the nut and wiring harness from the stud.



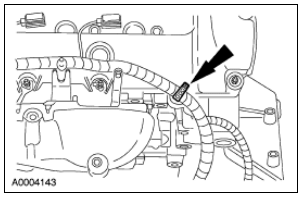
36. Detach the two wiring harness retainers from the block. Disconnect the generator electrical connector.



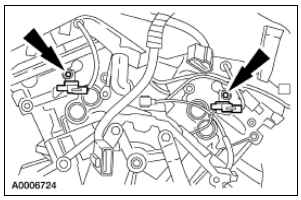
37. Remove the nuts.



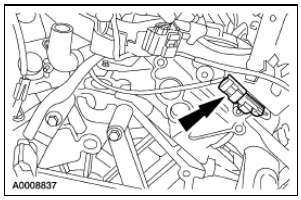
38. Unclip the wiring harness retainer.



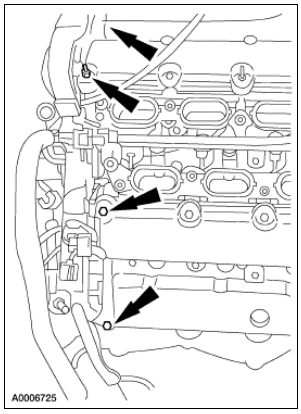
39. Remove the two bolts and the two radio ignition interference capacitors.



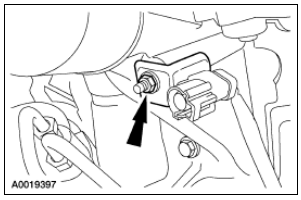
40. Unclip and disconnect the valley knock sensor electrical connector.



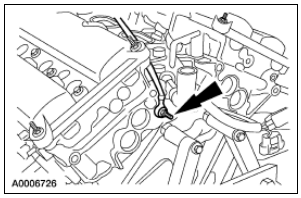
41. Remove the four nuts and the wiring harness.



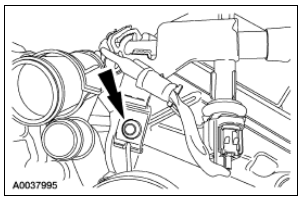
42. Remove the nut and the bracket.



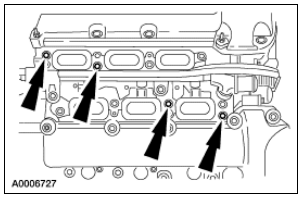
43. Remove the nut and the ground strap.



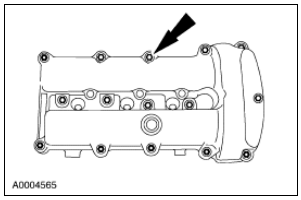
44. Remove the bolt.



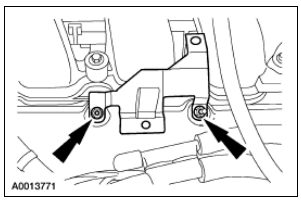
45. Remove the bolts and the lower intake manifold assembly.



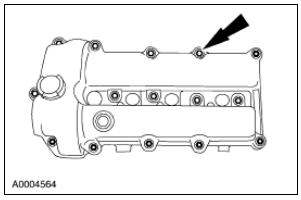
46. Remove the studs and bolts and remove the RH valve cover and gasket.
    - Discard the gasket.



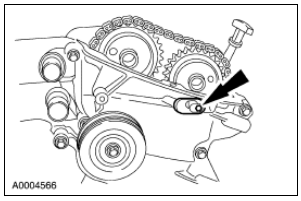
47. Remove the nuts and the appearance cover support bracket.



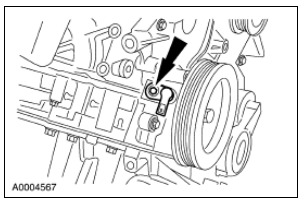
48. Remove the studs and bolts and remove the LH valve cover and gasket.
    - Discard the gasket.



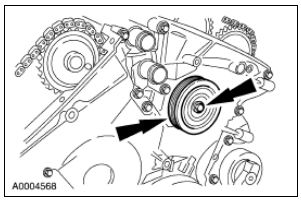
49. Remove the bolts and the CMP sensor.



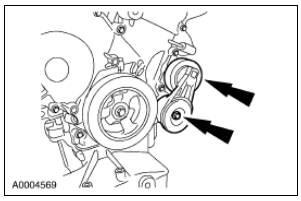
50. Remove the bolt and the CKP sensor.



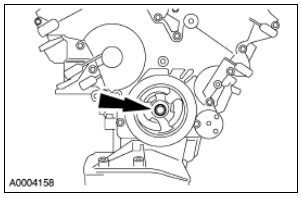
51. Remove the bolt and the idler pulley.



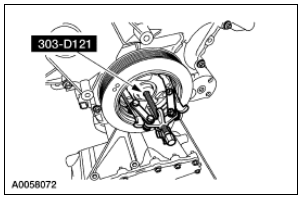
52. Remove the bolt and the drive belt tensioner.



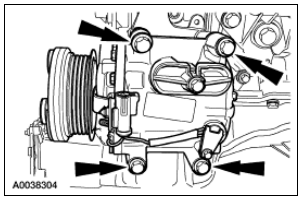
53. Remove and discard the bolt.



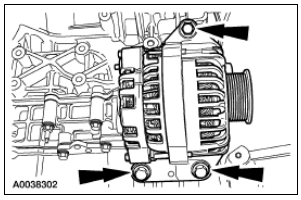
54. Using the special tool, remove the crankshaft pulley.



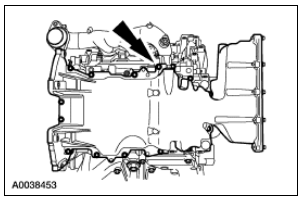
55. Remove the bolts and the A/C compressor.



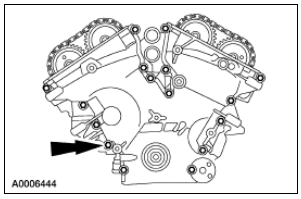
56. Remove the bolts and the generator.



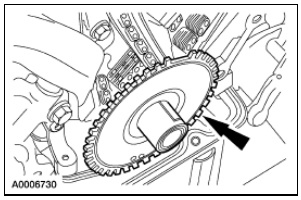
57. Remove the bolts, the oil pan and the oil pan gasket.
    - Discard the gasket.



58. Remove the bolts, the engine front cover and the gasket.
    - Discard the gasket.



59. Remove the ignition pulse ring.

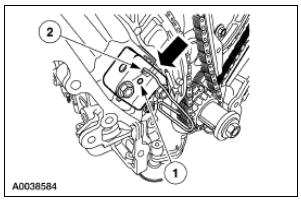


60. ⚠ **CAUTION: Rotating the crankshaft in a counterclockwise direction can cause possible engine damage. Crankshaft journals are directionally machined. Rotating the crankshaft counterclockwise can raise burrs on bearing surfaces, reducing engine life.**

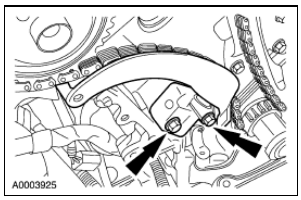
    ⚠ **CAUTION: If the RH timing chain tensioner arm and RH timing chain guide are to be reused, mark position of each to make sure of original position when reassembled.**

    Compress the timing chain tensioner.

    1. Release the racheting pawl.
    2. Compress the timing chain tensioner and install a stiff wire or paper clip.

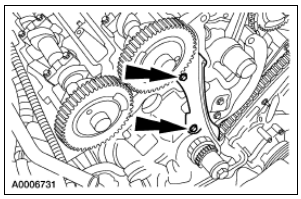


61. Remove the bolts, the timing chain tensioner and the tensioner arm.



62. Remove the RH timing chain.

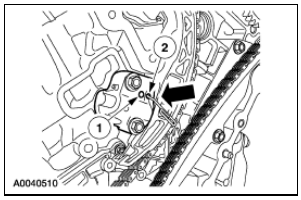
63. Remove the bolts and the RH timing chain guide.



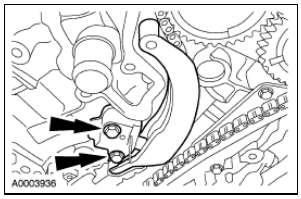
64. ⚠ **CAUTION: If the LH timing chain tensioner arm and the LH timing chain guide are to be reused, mark position of each to make sure of original position when reassembled.**

    Compress the timing chain tensioner.

    1. Release the racheting pawl.
    2. Compress the timing chain tensioner and install a stiff wire or paper clip.

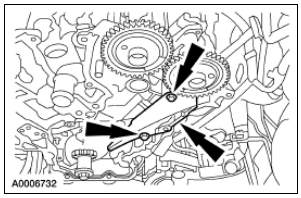


65. Remove the bolts, the timing chain tensioner and the tensioner arm.



66. Remove the LH timing chain.

67. Remove the bolts and the LH chain guide.



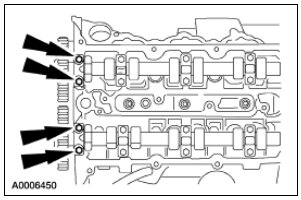
68. Remove the crankshaft sprocket.

69. ⚠ **CAUTION: Remove the camshaft journal thrust caps prior to loosening other camshaft journal cap bolts. Damage to the camshaft journal thrust cap can occur if not removed first.**

    ⚠ **CAUTION: Cylinder head camshaft journal caps and cylinder heads are numbered to be sure they are assembled in their original position. Keep camshaft journal caps with the cylinder head from which they were removed. Do not mix with camshaft journal caps from another cylinder head.**

    NOTE: LH side shown; RH side similar.

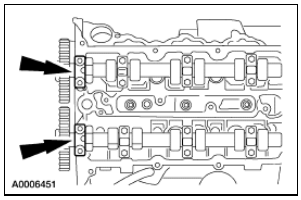
    Remove the LH and RH camshaft thrust cap bolts.



70. **NOTE:** LH side shown; RH side similar.

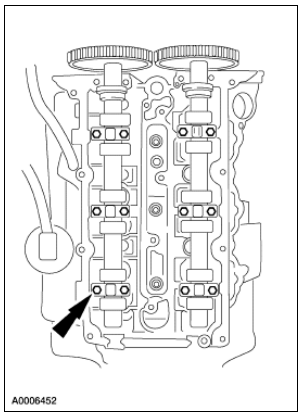
    NOTE: The camshaft journal thrust caps have alignment dowels.

    Using a soft-faced mallet, gently loosen and remove the LH and RH camshaft journal thrust caps.



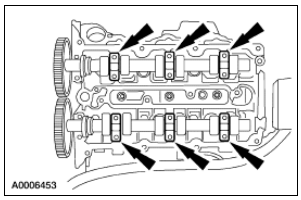
71. **NOTE:** LH side shown; RH side similar.

    Remove the remaining bolts.



72. **NOTE:** LH side shown; RH side similar.

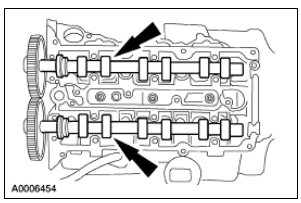
    Using a soft-faced mallet, gently loosen and remove the remaining camshaft journal caps.



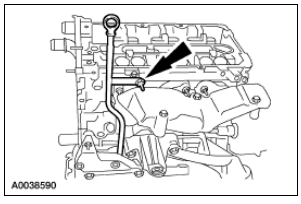
73. ⚠ **CAUTION: If the bucket tappets are to be reused, mark the position of the bucket tappets to make sure they are assembled in their original positions.**

    NOTE: LH side shown; RH side similar.

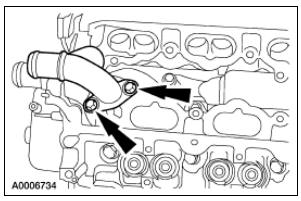
    Carefully lift out the LH and RH intake and exhaust camshafts.



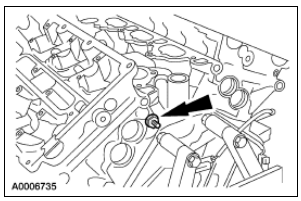
74. Remove the stud bolt and the oil level indicator tube.



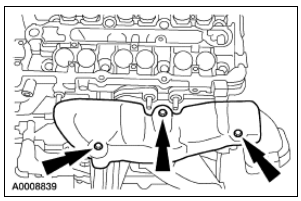
75. Remove the bolts and the coolant bypass tube.



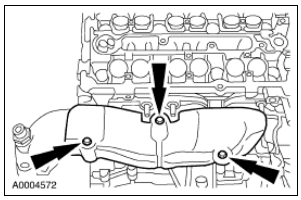
76. Remove the PCV tube stud.



77. If equipped, remove the bolts and the LH heat shield.



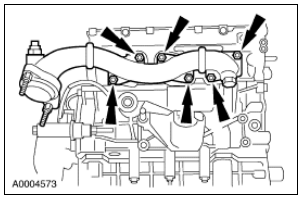
78. If equipped, remove the bolts and RH heat shield.



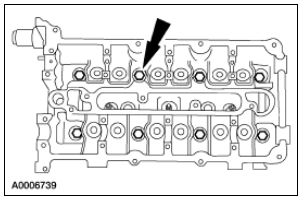
79. **NOTE:** RH side shown; LH side similar.

Remove the nuts and the RH and LH exhaust manifolds and gaskets.

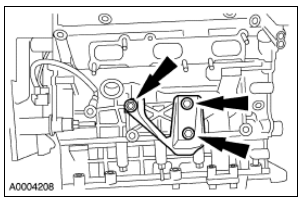
- Discard the gaskets.



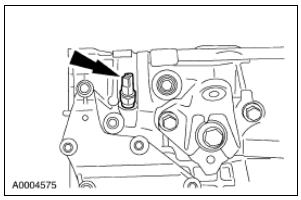
80. Remove the bolts and the RH and LH cylinder heads.
    - Discard the gaskets.



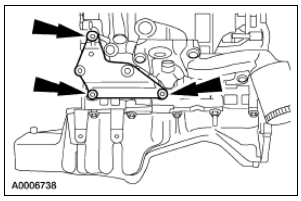
81. Remove the one stud, two bolts and the RH engine mount bracket.



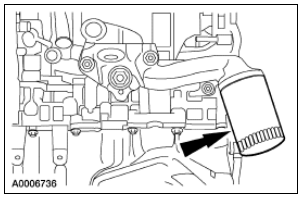
82. Remove the oil pressure switch.



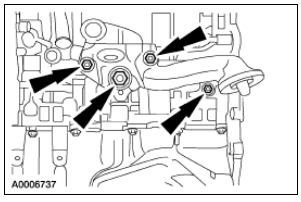
83. Remove the bolts and the A/C compressor mounting bracket.



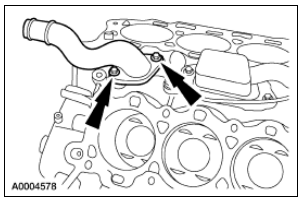
84. Remove the oil filter.



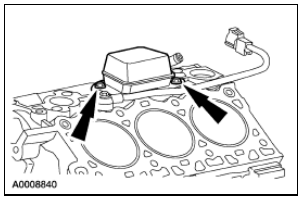
85. Remove the bolts and the oil filter adapter.



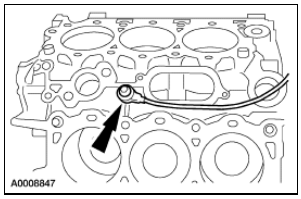
86. Remove the bolts and the inlet tube.



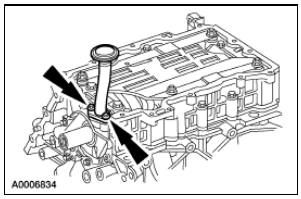
87. Remove the bolts and the oil separator.
    - Discard the gasket.



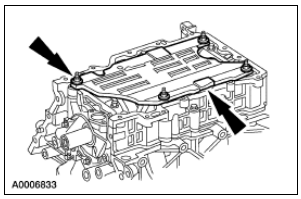
88. Remove the bolt and the top-mounted KS.



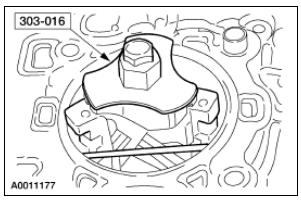
89. Remove the bolts and the oil pick-up tube.
    - Inspect the O-ring seal for damage.



90. Remove the nuts and the oil pan baffle.



91. Using the special tool, remove the cylinder ridge.

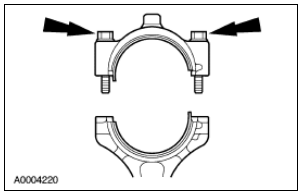


92. ⚠ **CAUTION: Pistons, connecting rods, connecting rod bearings and caps should be marked to be sure they are assembled in their original locations.**

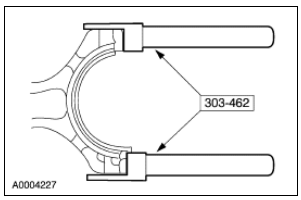
    Turn crankshaft until the piston to be removed is at the low point of its travel near the oil pan mounting.

93. **NOTE:** Connecting rod bearing caps are cracked and split from the connecting rods during manufacture, thereby providing an exact fit to the connecting rod when assembled. Care should be taken to prevent dirt or grease from contaminating the cap and rod mating surfaces. Identification marks on the cap and rod must remain aligned as a matched set during assembly.

    Remove the connecting rod cap retaining bolts, connecting rod cap and lower connecting rod bearing. Keep the cap and bearing together.



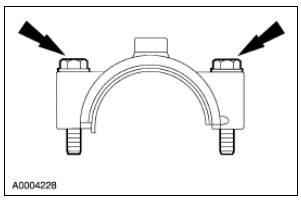
94. Using the special tool to protect the cylinder, push the piston, connecting rod and upper bearing assembly through the top of the cylinder bore.



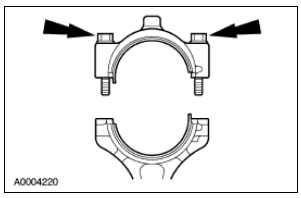
95. **⚠ CAUTION: Care should be taken not to damage the connecting rod and cap joint face surfaces or possible engine damage can occur.**

    ⚠ CAUTION: New connecting rod bolts must be installed. They are torque-to-yield and cannot be reused.

    Connecting rod bolts are retained in the connecting rod caps with a slight press fit. Using a hammer and punch, drive the bolts from the caps.

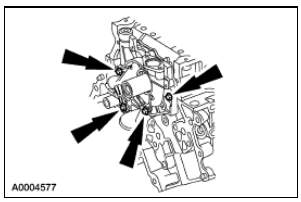


96. Using new connecting rod bolts, attach the connecting rod cap and lower bearing to the connecting rod and upper bearing to prevent mixing parts and damaging the connecting rod joint face surfaces.



97. If new piston rings must be installed, or piston and connecting rod disassembly is required, refer to Disassembly and Assembly of Subassemblies in this section.

98. Remove the bolts and the oil pump.

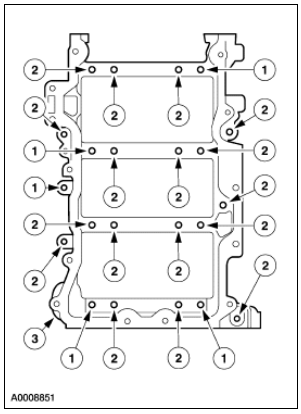


99. **⚠ CAUTION: The bolts are torque-to-yield and cannot be reused. New bolts must be installed.**

    NOTE: Note the location of the stud bolts for assembly.

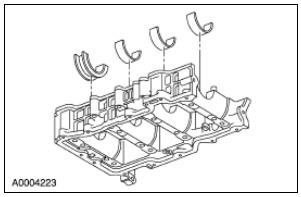
Remove the lower cylinder block.

1. Remove and discard the stud bolts.
2. Remove and discard the 17 bolts.
3. Remove the lower cylinder block.

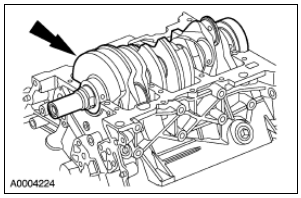


100. **NOTE:** If bearings are to be reused, mark the position of the upper and lower crankshaft main bearings and crankshaft thrust bearing.

Remove the lower crankshaft main bearings and crankshaft thrust bearing from the lower cylinder block.

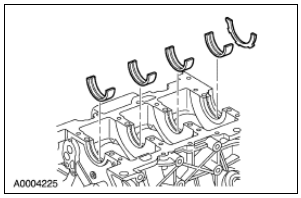


101. Carefully remove the crankshaft from the upper cylinder block.

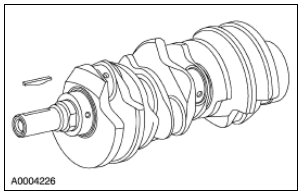


102. Remove and discard the crankshaft rear oil seal.

103. Remove the upper crankshaft bearings and thrust bearing from the upper cylinder block.



104. If necessary, remove the crankshaft key from the crankshaft keyway.

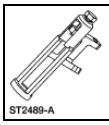


105. Remove the pipe plugs, engine block heater, and dowels from the cylinder block as necessary to clean foreign material from the oil and coolant passages.

106. Inspect the crankshaft, cylinder block and cylinder heads. For additional information, refer to Section 303-00 .

Cylinder Head

Special Tool(s)

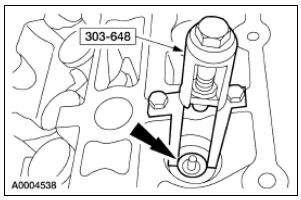
 ST2489-A	Compressor, Valve Spring 303-648

Material

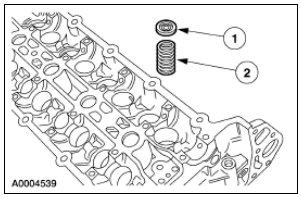
Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

Disassembly and Assembly

1. Using the special tool, remove the valve spring retainer key.

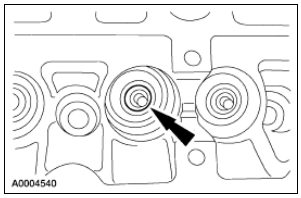


2. Remove the valve spring.
   - Remove the retainer.
   - Remove the spring.

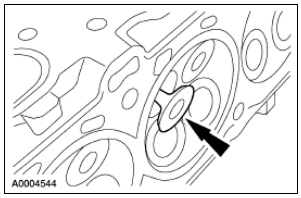


3. For component tests of the valve spring retainer, refer to Section 303-00 .

4. Remove the valve stem seal.



5. Remove the valve.
   - For component tests of the valve, refer to Section 303-00 .
   - For component tests of the cylinder head, refer to Section 303-00 .



6. Repeat the procedure until all of the valves are removed.

7. To assemble, reverse the disassembly procedure.
    - Lubricate the valve stem and the valve stem seal with clean engine oil.

Piston

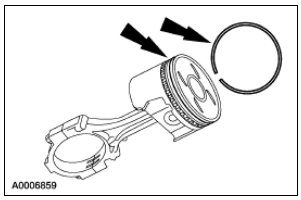
Material

Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

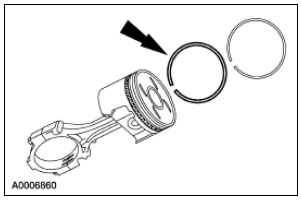
Disassembly

1. **NOTE:** Use a suitable ring expander to remove piston rings to prevent damage.

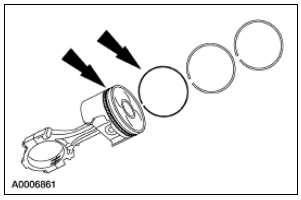
   Remove the top compression ring.



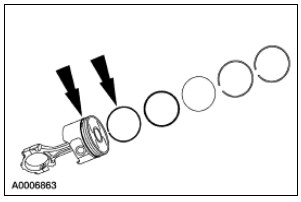
2. Remove the second compression ring.



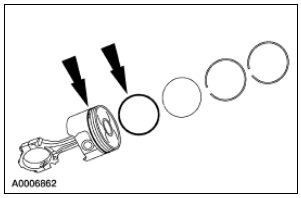
3. Remove the first oil control ring.



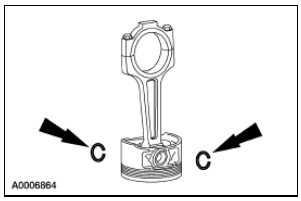
4. Remove the second oil control ring.



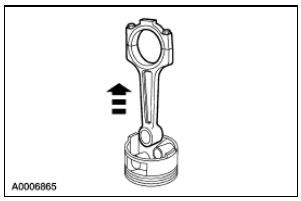
5. Remove the oil control spacer ring.



6. Remove the clips.



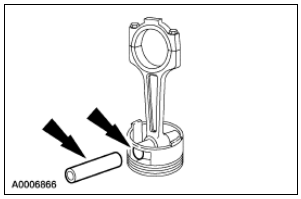
7. Remove the piston pin and the connecting rod from the piston.



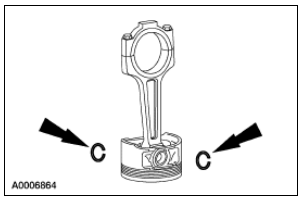
8. Clean and inspect the connecting rod and the piston. For additional information, refer to Section 303-00 .

Assembly

1. Lubricate the piston pin and piston pin bore with clean engine oil and install the piston pin.



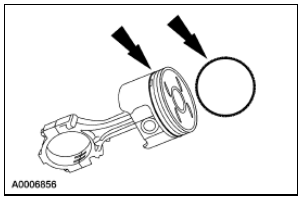
2. Install the clips.



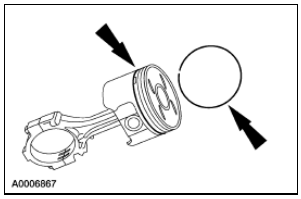
3. Check piston ring end gap. For additional information, refer to Section 303-00 .

4. Lubricate the piston and the piston rings with clean engine oil.

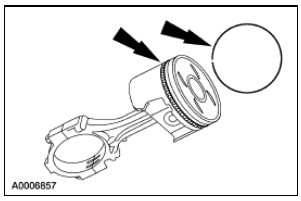
5. Install the oil control spacer ring.



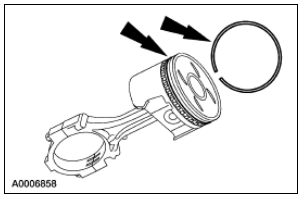
6. Install the second oil control ring.



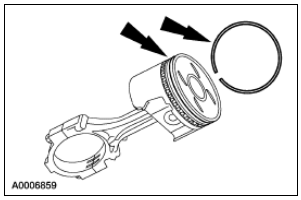
7. Install the first oil control ring.



8. Install the second compression ring.
    - The top of the second compression ring has a "0" on it. Position this side of the ring toward the top of the piston.

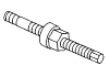
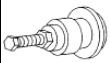
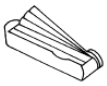
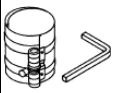
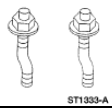


9. Install the top compression ring.
    - The top compression ring can be installed with either side up.



Engine

Special Tool(s)

 ST2429-A	Lift Tool, Camshaft 303-659
 ST2115-A	Installer, Connecting Rod 303-462 (T94P-6136-AH)
 ST1327-A	Installer, Crankshaft Rear Main Oil Seal 303-178 (T82L-6701-A)
 ST1287-A	Installation, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)
 ST1271-A	Feeler Gauge Set 303-D027 (D81L-4201-A)
	Compressor, Piston Ring 303-D032 (D81L-6002-C)
 ST1333-A	Installer Bolts, Crankshaft Rear Main 303-384 (T91P-6701-A)
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A)
 ST1595-A	Lifting Brackets, Engine 303-050

Material

Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H
Stud and Bearing Mount E0AZ-19554-BA or equivalent	WSK-M2G349-A1
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
	WSE-M5B392-A

Metal Surface Cleaner F4AZ-19A536-RA or equivalent	

1. ⚠ **WARNING: Eye protection is required to be worn during the use of compressed air. Failure to follow these instructions can result in possible personal injury.**

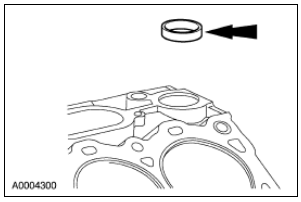
   NOTE: If required, deglaze the cylinder walls using a suitable spring-type tool. Clean the cylinder walls with a detergent and water solution upside-down to prevent contamination of the lower portion of the cylinder block.

   Clean gasket material, dirt and foreign material from the cylinder block. Wash the cylinder block with a suitable soap and water solution, and dry with compressed air.

2. Install the cup plugs, block dowels or pipe plugs that may have been removed during disassembly. Tighten the pipe plugs as follows:
   - 3/8-18 inch to 20 Nm (15 lb-ft) + 180 degrees
   - 1/2-14 inch to 40 Nm (30 lb-ft) + 180 degrees
   - 3/4-14 inch to 10 Nm (89 lb-in) + 720 degrees or 40 Nm (30 lb-ft), whichever comes first. Do not exceed 720 degrees or 40 Nm (30 lb-ft).

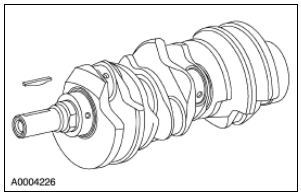
3. Measure the cylinder bore diameter and compare to specification. Cylinder bore measurements should be taken within 50 mm (2 in) from the top of the bore. Mark the outside of the block with the appropriate bore grade number for the replacement piston. Replacement pistons and domes are marked with grade numbers. For additional information, refer to Section 303-00 .

4. If removed, install cup plugs. Apply a 2 mm (0.08 in) bead of stud and bearing mount to the cup plug prior to installation.



5. If removed, install the engine block heater. For additional information, refer to Section 303-03 .

6. If removed, install the crankshaft key into the keyway on the crankshaft.

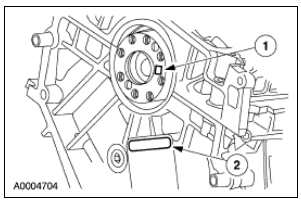


7. **NOTE:** This procedure is for selecting bearings using a new crankshaft.

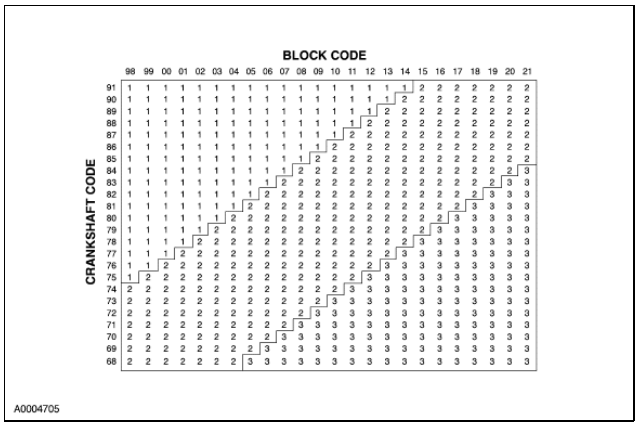
   Select the crankshaft main bearings for each crankshaft journal.

   1. Read the code on the crankshaft flange.
   2. Read the code on the cylinder block rear face.
   - The first two numbers after the asterisk make up the code for main No. 1 and the next two numbers for main No. 2.
   - The first two numbers after the second asterisk make up the code for main No. 3 and the last

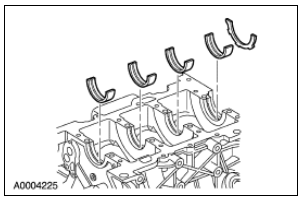
two numbers for main No. 4.



8. Look at the Select-Fit Chart and for each main, match the block and crankshaft code with its corresponding column or row, by reading across the crankshaft row and down the block column. Select the proper grade bearing for each main.
    - For example: If the block code is *0609*0711* and the crankshaft code is *8480*8082*, main No. 1 should use grade 1 bearings, as determined by the intersection of the 06 block column and the 84 crankshaft row. Main Nos. 2, 3 and 4 should all be grade 2.

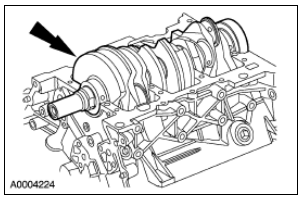


9. Install the upper main bearing and upper thrust bearing into the cylinder block in the correct locations.

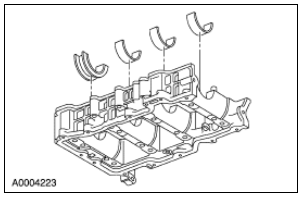


10. **NOTE:** Lubricate the crankshaft main bearings and the crankshaft journals with clean engine oil.

    Carefully install the crankshaft into the cylinder block.



11. Install the lower main bearings and lower thrust bearing into the lower cylinder block in the correct locations.

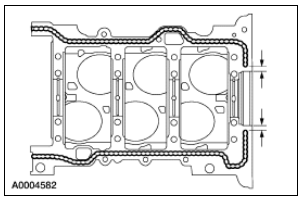


12. ⚠ **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs, or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which may make leak paths. Use a plastic scraper to remove all traces of old sealant.**

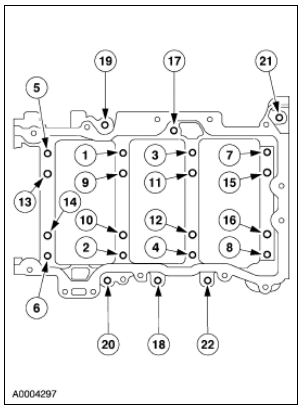
    NOTE: Both sealing surfaces must be clean, dry and free of any dirt or other contamination prior to application of the sealant, Use metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

    NOTE: The lower cylinder block and bolts, with all bolts tightened, must be assembled within four minutes of applying sealer.

    Apply a 3 mm (0.12 in) bead of silicone gasket and sealant to the lower cylinder block ending 6 mm (0.24 in) from the rear crankshaft seal bore on both sides.



13. Install the lower cylinder block and bolts.
    - Tighten the bolts in the sequence shown in four stages.
    - Stage 1: Tighten numbers 1 through 8 to 25 Nm (18 lb-ft).
    - Stage 2: Tighten numbers 9 through 16 to 40 Nm (30 lb-ft).
    - Stage 3: Rotate numbers 1 through 16 an additional 90 degrees.
    - Stage 4: Tighten numbers 17 through 22 to 25 Nm (18 lb-ft).



14. Remove the squeezed out sealer at the engine front cover surface and the rear seal bore inner diameter.

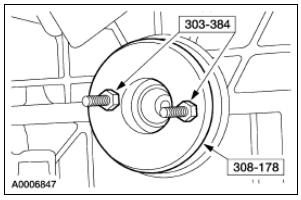
15. Check crankshaft end play. For additional information, refer to Section 303-00 .

16. ⚠ **CAUTION: Rotating the crankshaft in a counterclockwise direction can cause engine damage. Crankshaft journals are directionally machined. Rotating the crankshaft counterclockwise can raise burrs on bearing surfaces, reducing engine life.**

Rotate the crankshaft clockwise to verify free rotation.

17. **NOTE:** Apply clean engine oil to the crankshaft flange outer diameter and to the crankshaft seal bore inner diameter prior to seal installation.

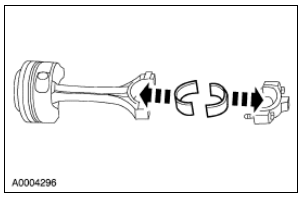
    Using the special tool, install the crankshaft rear oil seal.



18. Select the correct size connecting rod bearings. For additional information, refer to Section 303-00 .

19. **NOTE:** The connecting rod bearing tangs should align with the notch in the connecting rod and cap.

    Install the connecting rod bearings into the connecting rods and connecting rod caps.



20. ⚠ **CAUTION: Be sure not to scratch the cylinder wall or crankshaft journal with the connecting rod. Push the piston down until the connecting rod bearing seats on the crankshaft journal.**

    NOTE: Lubricate the pistons, piston rings, connecting rod bearings and entire cylinder bores with clean engine oil prior to installation.

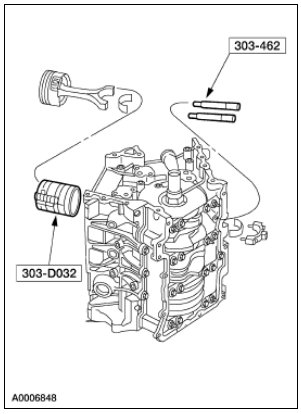
    NOTE: Check piston rings for correct orientation prior to installing piston into cylinder bore. For additional information, refer to Section 303-00 .

    NOTE: Install pistons with arrows on pistons to front of engine.

    NOTE: After installation of each piston and connecting rod, rotate the crankshaft to verify smooth operation.

    Turn the crankshaft until the crankshaft throw is at the bottom of the stroke. Using the special tools, install the piston, connecting rod, and connecting rod bearing assemblies Nos. 1 and 4. Tighten the bolts in three stages:

    - Stage 1: Tighten to 23 Nm (17 lb-ft).
    - Stage 2: Tighten to 43 Nm (32 lb-ft).
    - Stage 3: Tighten an additional 90 degrees.

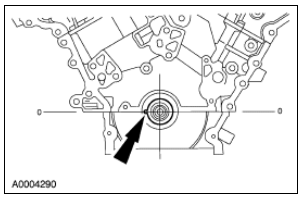


21. Install the piston, connecting rod and connecting rod bearing assemblies Nos. 2 and 5. Tighten the bolts in three stages:
    - Stage 1: Tighten to 23 Nm (17 lb-ft).
    - Stage 2: Tighten to 43 Nm (32 lb-ft).
    - Stage 3: Tighten an additional 90 degrees.

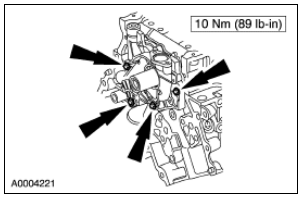
22. Install the piston, connecting rod and connecting rod bearing assemblies Nos. 3 and 6. Tighten the bolts in three stages:
    - Stage 1: Tighten to 23 Nm (17 lb-ft).
    - Stage 2: Tighten to 43 Nm (32 lb-ft).
    - Stage 3: Tighten an additional 90 degrees.

23. Check the connecting rod side clearance for all of the connecting rods. For additional information, refer to Section 303-00 .

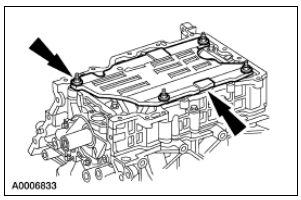
24. Rotate the crankshaft to position the keyway at the nine o'clock position.



25. Position the oil pump and install the bolts.



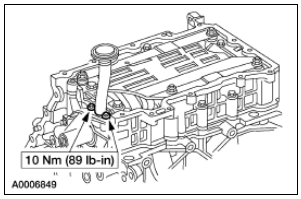
26. Position the oil pan baffle and install the nuts. Tighten in two stages:
    - Stage 1: Tighten to 5 Nm (44 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



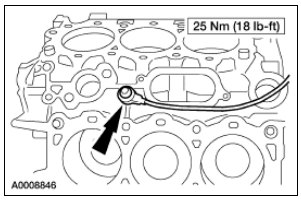
27. **NOTE:** Lubricate the O-ring seal with clean engine oil before installing.

    Position the oil pump screen cover and tube and install the bolts.

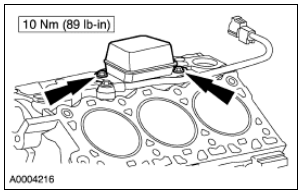
    - Use a new O-ring seal if necessary.



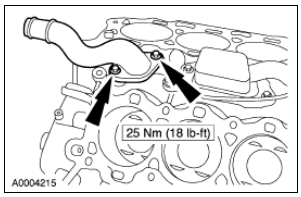
28. Position the top-mounted KS and install the bolt.



29. Using a new gasket, position the oil separator and install the bolts.



30. Using a new O-ring seal, position the coolant inlet tube and install the bolts.



31. **⚠ CAUTION: The cylinder head gasket surfaces are ground to a precision finish. Do not rest cylinder heads on gasket surfaces. Do not use any abrasive during cleaning of the surfaces. Hairline scratches, small burrs, or dirt can provide a leak path for a cylinder head gasket to leak. If gasket material remains on the sealing surface, use only a plastic-tipped scraper to remove the material. Do not attempt to reuse the head gaskets.**

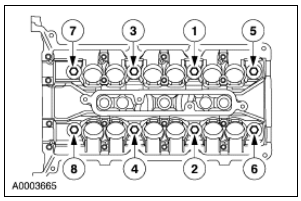
    ⚠ CAUTION: Cylinder head bolts are torque-to-yield and cannot be reused.

    NOTE: The LH and RH cylinder head gaskets are not interchangeable.

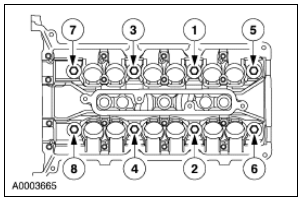
    Using a new cylinder head gasket, position the RH cylinder head, and install the bolts.

    - Tighten the bolts in six stages:
    - Stage 1: Tighten to 30 Nm (22 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.
    - Stage 3: Back out a minimum of one full turn (360 degrees).
    - Stage 4: Tighten to 30 Nm (22 lb-ft).

- Stage 5: Tighten an additional 90 degrees.
- Stage 6: Tighten an additional 90 degrees.



32. Using a new cylinder head gasket, position the LH cylinder head, and install the bolts.
    - Tighten the bolts in six stages:
    - Stage 1: Tighten to 30 Nm (22 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.
    - Stage 3: Back out a minimum of one full turn (360 degrees).
    - Stage 4: Tighten to 30 Nm (22 lb-ft).
    - Stage 5: Tighten an additional 90 degrees.
    - Stage 6: Tighten an additional 90 degrees.



33. ⚠ **CAUTION: The tappets and shims must be installed in their original positions.**

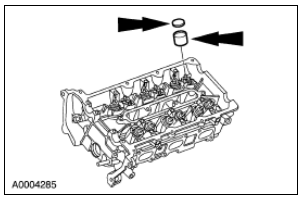
    ⚠ **CAUTION: The bucket tappets and bores must be absolutely clean prior to bucket tappet installation. Failure to correctly clean these components may result in a sticking valve leading to severe engine damage or failure.**

    NOTE: Only lightly lubricate the tappet shim prior to installation. Excess oil on the tappet shim may cause inaccurate valve clearance measurements.

    NOTE: LH side shown; RH side similar.

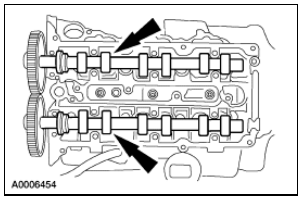
    Lubricate all of the valve tappets, shims and bores, and install them in their original positions.

    - Lubricate the valve tappets and bores with clean engine oil.
    - Lubricate the shims with clean engine oil.



34. **NOTE:** Be sure camshaft bearing caps are installed in their original positions.

    Lubricate the LH camshafts with clean engine oil and carefully position the camshaft into the LH cylinder head.

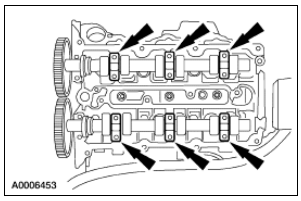


35. **⚠ CAUTION: This is not a free-spinning engine. The crankshaft keyway must be at the nine o'clock position prior to tightening the camshaft caps or rotating the camshafts. Failure to follow these directions can result in serious engine damage.**

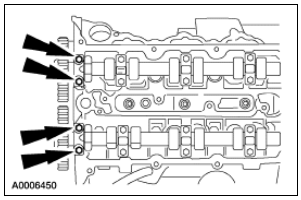
    ⚠ CAUTION: Cylinder head camshaft journal caps are numbered. Keep camshaft journal caps with the cylinder head from which they were removed. Do not mix with camshaft journal caps from another cylinder head.

    ⚠ CAUTION: Do not install the camshaft journal thrust caps until all of the camshaft bearing journal caps have been tightened, or damage to the thrust caps can occur.

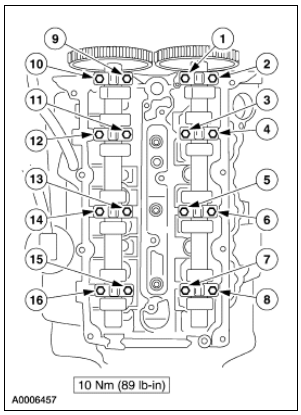
    Lubricate the LH camshaft bearing journal caps with clean engine oil. Position the caps in their correct locations and loosely install the bolts.



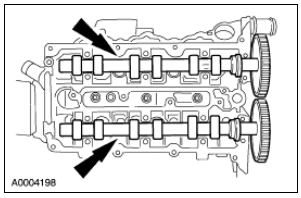
36. Lubricate the LH camshaft thrust caps with clean engine oil and position the caps and loosely install the bolts.



37. Tighten the bolts in sequence shown.



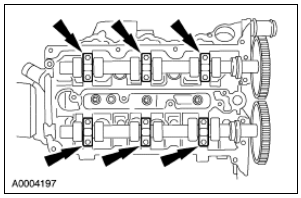
38. Lubricate the RH camshafts with clean engine oil and carefully position the camshaft into the RH cylinder head.



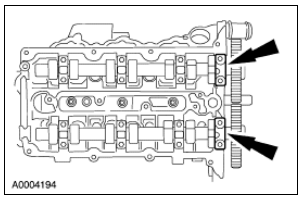
39. ⚠ **CAUTION: Cylinder head camshaft journal caps and cylinder heads are numbered to make sure they are installed in their original position. Keep camshaft journal caps with the cylinder head from which they were removed. Do not mix with camshaft journal caps from another cylinder head.**

    ⚠ **CAUTION: Do not install the camshaft journal thrust caps until all of the camshaft bearing journal caps have been tightened or damage to the thrust caps can occur.**

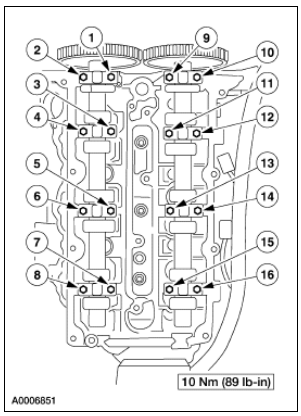
    Lubricate the camshaft bearing journal caps with clean engine oil. Position the caps in their correct locations and loosely install the bolts.



40. Lubricate the RH camshaft thrust caps with clean engine oil and loosely install the caps and bolts.

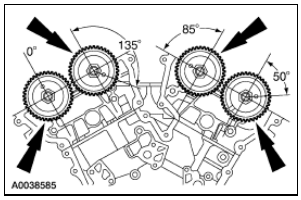


41. Tighten the camshaft journal cap bolts in the sequence shown.



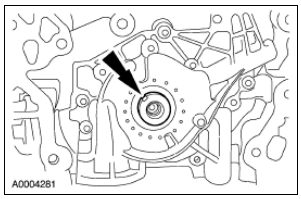
42. ⚠ **CAUTION: The crankshaft keyway must remain in the nine o'clock position until the cams are located, or damage to the valves can occur.**

    Rotate each camshaft to make sure there is smooth rotation and to position the cams in their neutral position.



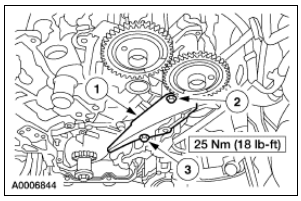
43. Install the crankshaft pulley and tighten the bolt.

44. Rotate the crankshaft clockwise to position the keyway to the 11 o'clock position.

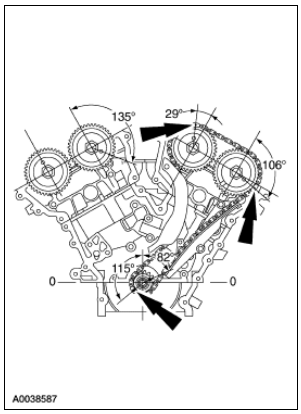


45. Remove the bolt and the crankshaft pulley.

46. Install the LH timing chain guide.
    1. Position the guide to the engine.
    2. Install the shorter (gold color) bolt into the upper hole.
    3. Install the longer bolt (black color) into the lower hole.

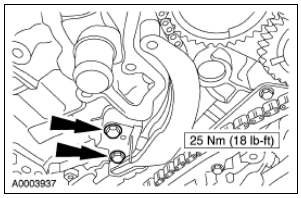


47. Install the LH timing chain, aligning the timing index link (gold color) with the marks on the camshaft and crankshaft sprockets.

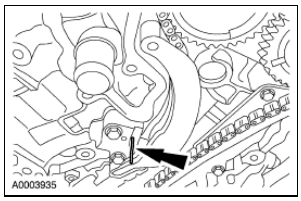


48. **NOTE:** Be sure to position the tensioner so that the tensioner piston is fully engaged in the tensioner arm.

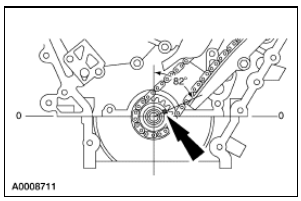
    Install the LH tensioner arm, tensioner and tensioner bolts.



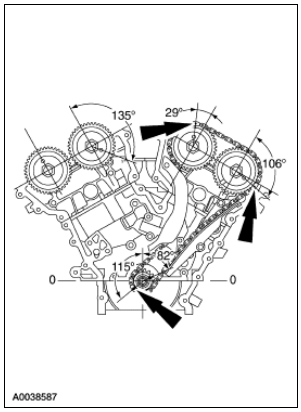
49. Remove the wire or paper clip from the tensioner.



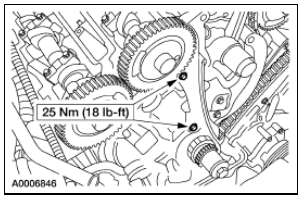
50. Rotate the crankshaft clockwise and position the keyway between the 2 o'clock and 3 o'clock positions for RH timing chain installation.



51. Verify that the timing index links (gold color) on the LH timing chain are in alignment with the timing index marks on the camshaft and crankshaft sprockets.



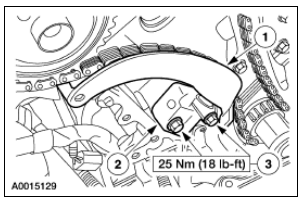
52. Install the RH chain guide and bolts.



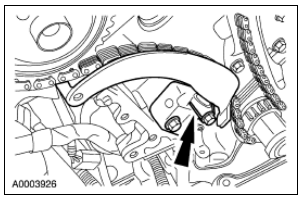
53. Install the RH timing chain, aligning the timing index links (gold color) with the marks on the camshaft and crankshaft sprockets.

54. Install the RH tensioner.
    1. Position the tensioner arm.
    2. Position the tensioner.

3. Install the bolts.



55. Remove the wire or paper clip from the RH tensioner.

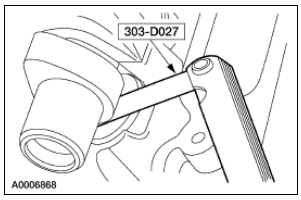


56. ⚠ **CAUTION: Rotating the crankshaft in a counterclockwise direction may cause engine damage. Crankshaft journals are directionally machined. Rotating the crankshaft counterclockwise can raise burrs on bearing surfaces, reducing engine life.**

    ⚠ **CAUTION: Camshaft lobes must be 180 degrees away from each valve tappet or valve lash measurements will be incorrect.**

    Rotate the engine clockwise to position the camshaft lobe away from the shim surface.

57. Using the special tool, measure the clearance between the camshaft lobe and the shim surface. Record the information.

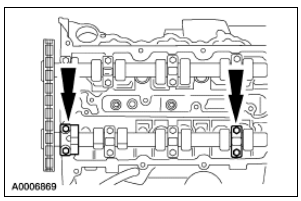


58. Use a bright colored marker to mark the position of the timing chain in relation to the camshaft sprockets to make sure that the timing remains correct.

59. ⚠ **CAUTION: The camshaft caps must be installed in their original positions.**

    Mark the camshaft caps location.

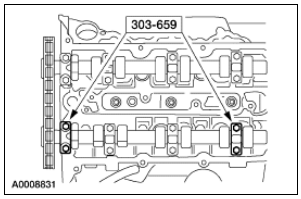
60. Remove the camshaft thrust cap and rear camshaft cap from the camshaft that requires shim adjustment.



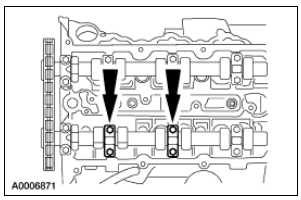
61. **NOTE:** The taller special tool is installed in place of the rear camshaft cap to allow the camshaft to be lifted to remove the shims.

Install the special tool.

- Hand-tighten the bolts.



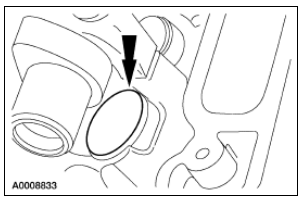
62. Remove the bolts and the center camshaft caps.



63. ⚠ **CAUTION: Do not use any means of marking the shims other than a permanent type marker. Any scratches or paint on the shims can result in incorrect lash adjustments and severe engine damage.**

    Use a permanent marker to mark the location of each shim.

64. Use a rubber-tipped air gun and compressed air to remove the shims that require adjustment.
    - Blow compressed air between the shim edge and bucket rail to dislodge the shim.



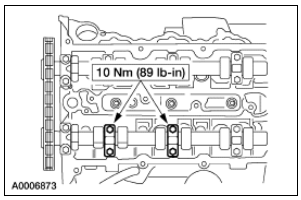
65. Measure and record the thickness of each shim to correspond with the valve clearance.

66. Use the following formula to calculate the required shim thickness.
    - Valve clearance specification:
        - ♦ Intake: 0.175 mm - 0.225 mm (0.0069 in - 0.0089 in)
        - ♦ Exhaust: 0.325 mm - 0.375 mm (0.0128 in - 0.0148 in)
    - Original shim thickness + measured clearance - desired clearance = required shim thickness.

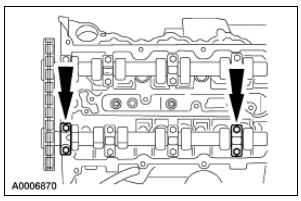
67. Apply a light coat of clean engine oil to the replacement shim(s) and install the shim(s).

68. Apply clean engine oil to the camshaft journals and bearing caps.

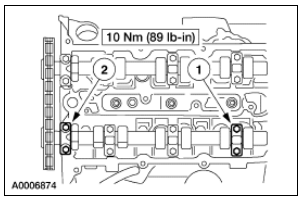
69. Position the center camshaft journal caps and install the bolts.



70. Remove the bolts and the special tools.

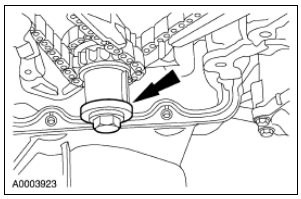


71. Install the camshaft caps.
    1. Position the rear camshaft journal cap and install the bolts.
    2. Position the camshaft journal thrust cap and install the bolts.

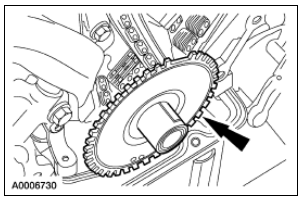


72. Rotate the engine clockwise to rotate the camshafts two full revolutions and recheck the valve clearance.

73. Remove the bolt and washer.

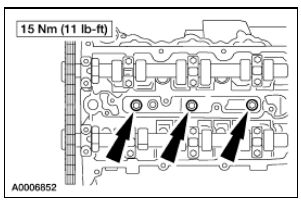


74. Install the ignition pulse ring.

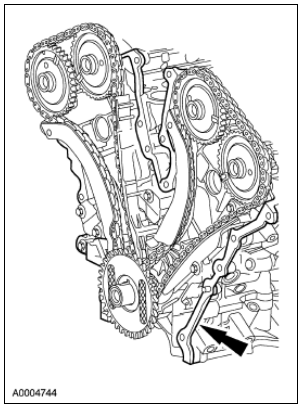


75. **NOTE:** LH shown; RH similar.

    Install the LH and RH spark plugs.



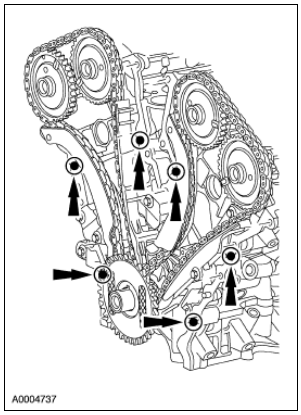
76. Clean the engine front cover to cylinder block and cylinder head sealing surfaces, using a clean shop towel and Metal Surface Cleaner to remove all residue.



77. Install new front cover seals into the front cover.

78. **NOTE:** Install the engine front cover and bolts no more than four minutes after applying sealer.

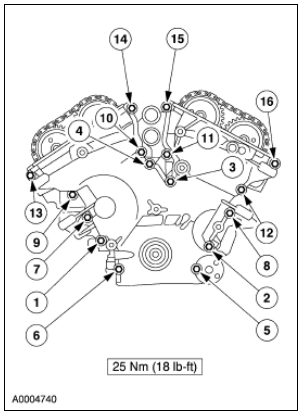
    Apply a 6 mm (0.24 in) diameter dot of silicone gasket and sealant to the areas shown.



79. **NOTE:** Fastener No. 14 is a stud bolt.

    Install the engine front cover and the bolts.

    - Tighten the bolts in the sequence shown.

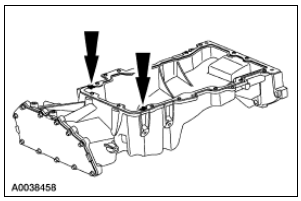


80. Rotate the engine upside down on the engine stand.

81. Clean the oil pan-to-cylinder block sealing surfaces on the oil pan and cylinder block with a clean shop towel and metal surface cleaner to remove all residues.

82. **NOTE:** Install the oil pan and bolts no more than four minutes after applying sealer.

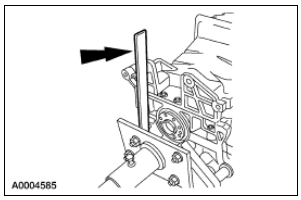
    Apply a 10 mm (0.4 in) dot of silicone gasket and sealant onto the top of the new oil pan gasket at the two locations shown.



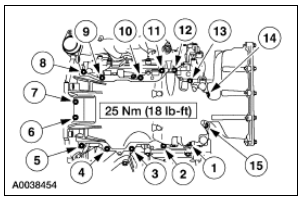
83. **NOTE:** The oil pan rear face must be installed flush to the cylinder block rear face to within +/- 0.10mm (0.0039 in). Failure to maintain this specification will require the oil pan to be removed and installed again.

    Install the oil pan.

    - Using a straightedge, align the rear face of the oil pan with the rear face of the cylinder block.

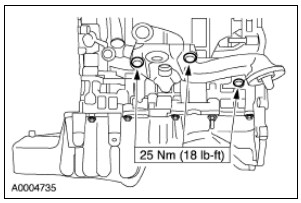


84. Tighten the oil pan bolts in the sequence shown.



85. **NOTE:** Non-oil cooler equipped engine shown. Engines equipped with oil cooler are similar.

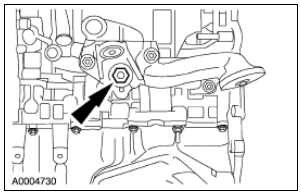
    Position the oil filter adapter and a new O-ring seal, and install the bolts.



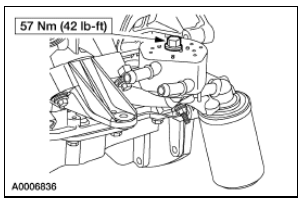
86. **NOTE:** Non-oil cooler equipped engine shown. Engines equipped with oil cooler are similar.

    Using a new O-ring seal, lubricate with clean engine oil and install the bolt.
    Tighten the bolt in two stages:

    - Stage 1: Tighten to 30 Nm (22 lb-ft).
    - Stage 2: Tighten to 155 Nm (114 lb-ft).

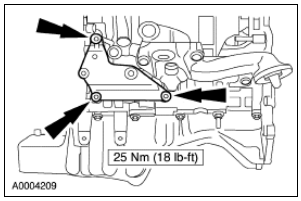


87. On vehicles equipped with an oil cooler, position the oil cooler and gasket and install the bolt.
    - Rotate the cooler clockwise until the location pin hits the stop.

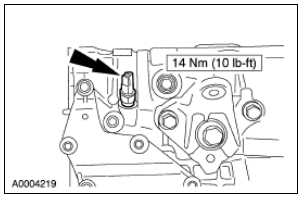


88. Lubricate the oil filter sealing ring with clean engine oil and install the oil filter.

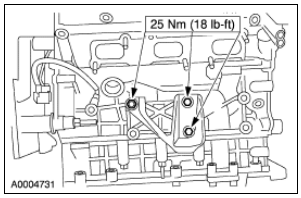
89. Position the A/C compressor mounting bracket and install the bolts.



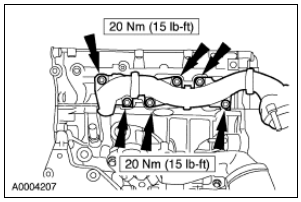
90. Install the oil pressure switch.



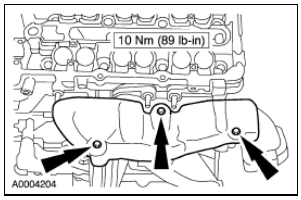
91. Position the RH engine mount bracket and install the bolts.



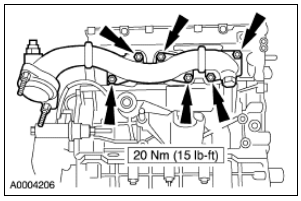
92. Using a new gasket, position the LH exhaust manifold and install the nuts.



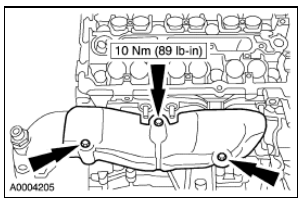
93. If equipped, position the LH heat shield and install the bolts.



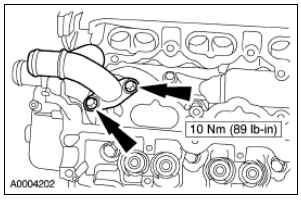
94. Using a new gasket, position the RH exhaust manifold and install the nuts.



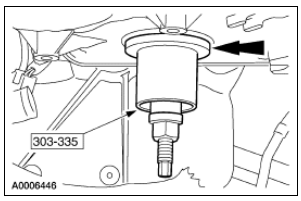
95. If equipped, position the RH heat shield and install the bolts.



96. Using new O-ring seals, install the coolant bypass tube.

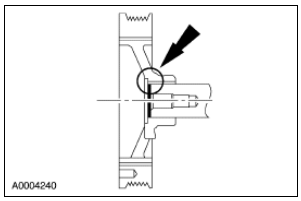


97. Using the special tool, install the crankshaft front oil seal.

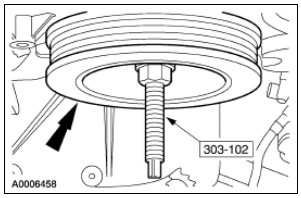


98. **NOTE:** Install the crankshaft damper no more than four minutes after applying the sealer.

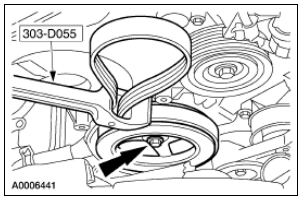
Apply a dot of silicone gasket and sealant to the crankshaft damper keyway slot.



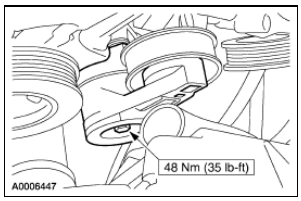
99. Using the special tool, install the crankshaft damper.



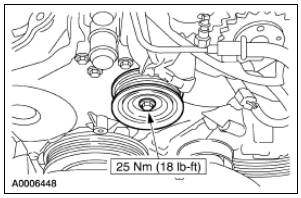
100. Using the special tool, install the washer and a new bolt.
Tighten the bolt in four stages:
- Stage 1: Tighten to 120 Nm (89 lb-ft).
- Stage 2: Back out a minimum of one full turn (360 degrees).
- Stage 3: Tighten to 50 Nm (37 lb-ft).
- Stage 4: Tighten an additional 90 degrees.



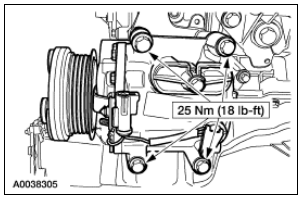
101. Position the belt tensioner and install the bolt.



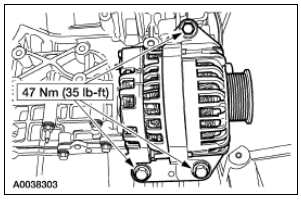
102. Position the idler pulley and install the bolt.



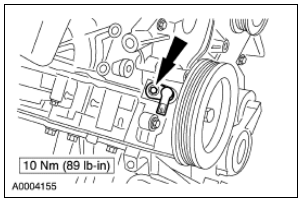
103. Install the A/C compressor and mounting bolts.



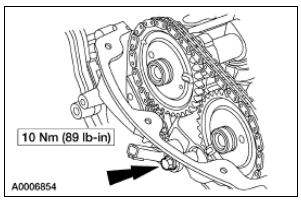
104. Install the generator and the mounting bolts.



105. Position the crankshaft position (CKP) sensor and install the bolt.



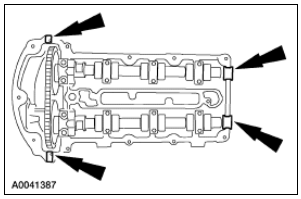
106. Position the camshaft position (CMP) sensor and install the bolt.



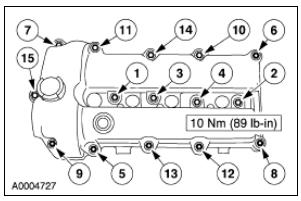
107. Install a new gasket in the LH valve cover.

108. **NOTE:** Install the valve cover and bolts no more than four minutes after installing the sealer.

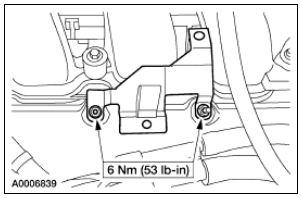
    Apply an 8 mm (0.32 in) bead of silicone gasket and sealer to the cylinder half round surface and to the front cover gasket intersection places.



109. Position the LH valve cover and install the bolts in the sequence shown.



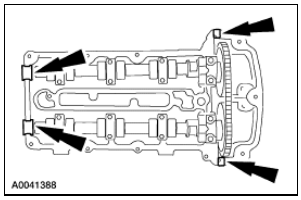
110. Install the appearance cover support bracket.



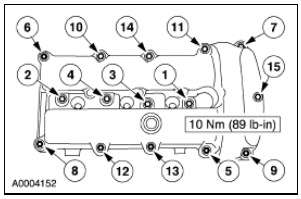
111. Install a new gasket in the RH valve cover.

112. **NOTE:** Install the valve cover and bolts no more than four minutes after applying the sealer.

    Apply an 8 mm (0.32 in) bead of silicone gasket and sealant to the cylinder half round surface and to the front cover gasket intersection places.

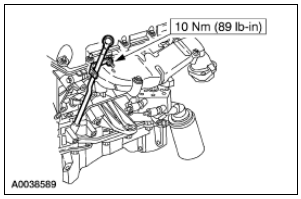


113. Position the RH valve cover and install the bolts in the sequence shown.

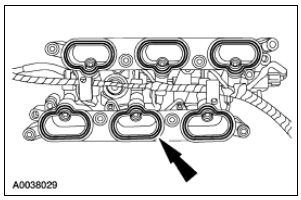


114. **NOTE:** Lubricate the O-ring seal with clean engine oil before installing.

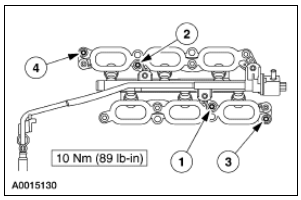
Install the oil level indicator and tube and install the stud bolt.



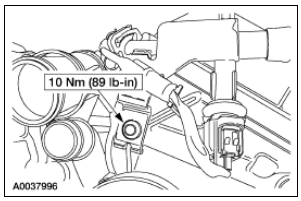
115. Inspect the lower intake manifold gaskets. Install new gaskets if necessary.



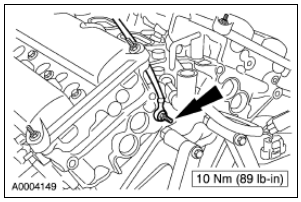
116. Position the lower intake manifold assembly and install the bolts in the sequence shown.



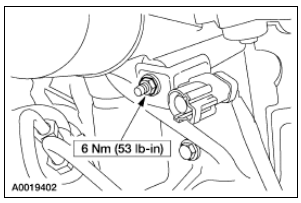
117. Install the fuel manifold bolt.



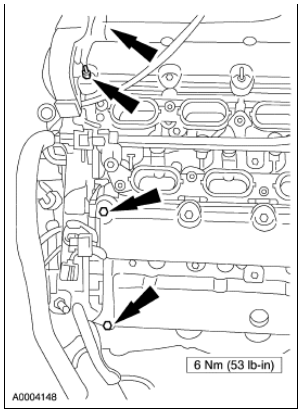
118. Position the ground strap and install the nut.



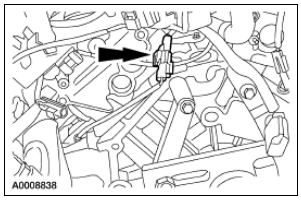
119. Install the bracket and the nut.



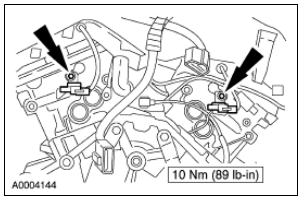
120. Position the wiring harness and install the four nuts.



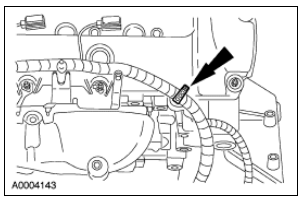
121. Connect the valley KS electrical connector and clip it into the retainer.



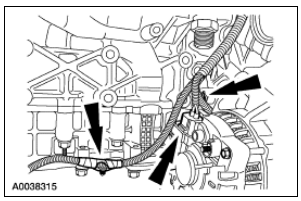
122. Position the two radio ignition interference capacitors and install the bolts.



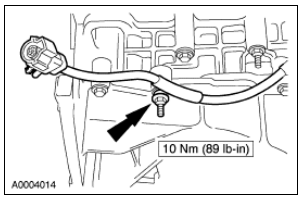
123. Attach the wiring harness retainer.



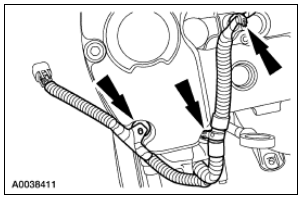
124. Clip the two wiring harness retainers into the brackets and connect the generator electrical connector.



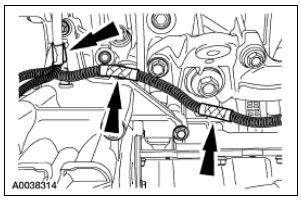
125. Position the wiring harness and install the nut.



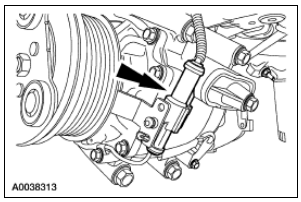
126. Attach the three wiring harness retainers.



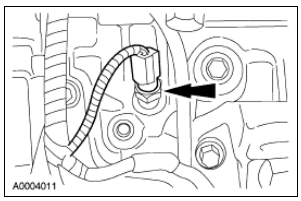
127. Attach the three wiring harness retainers.



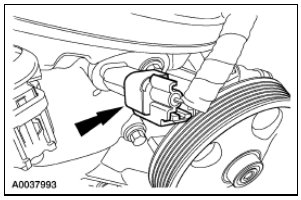
128. Connect the A/C electrical connector.



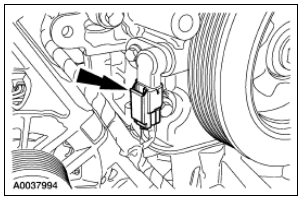
129. Connect the oil pressure switch electrical connector.



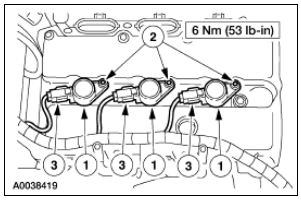
130. Connect the CMP sensor electrical connector.



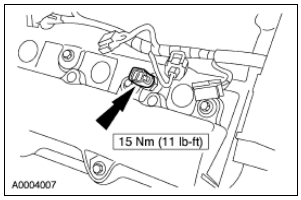
131. Connect the CKP sensor electrical connector.



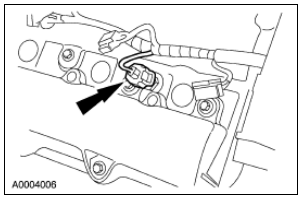
132. Install the RH ignition coils.
    1. Install the RH ignition coils.
    2. Install the bolts.
    3. Connect the electrical connectors.



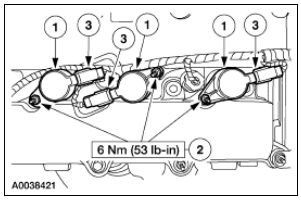
133. Install the cylinder head temperature (CHT) sensor.



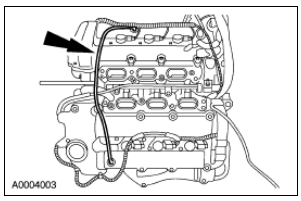
134. Connect the CHT sensor electrical connector.



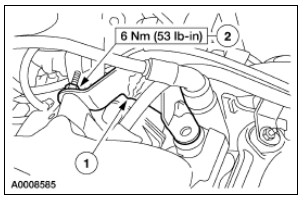
135. Install the LH ignition coils.
    1. Install the LH ignition coils.
    2. Install the three studs.
    3. Connect the electrical connectors.



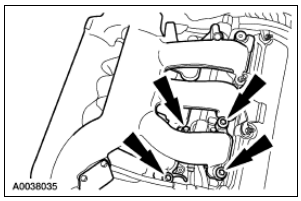
136. Install the crankcase ventilation tube.



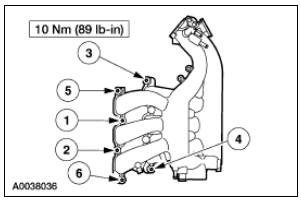
137. Install the fuel pressure sensor shield.
    1. Position the shield.
    2. Install the nut.



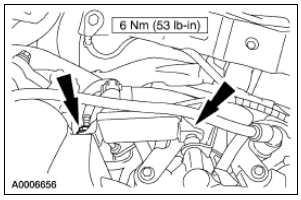
138. Position the upper intake manifold and gaskets. Install the bolts finger tight.



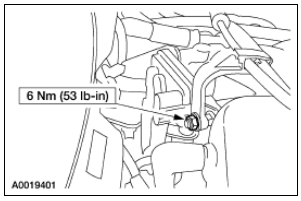
139. Tighten the upper intake bolts in the sequence shown.



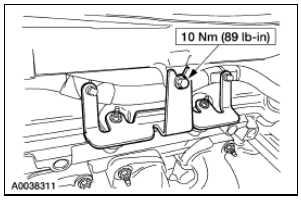
140. Position the differential pressure sensor EGR transducer and install the nut and stud.



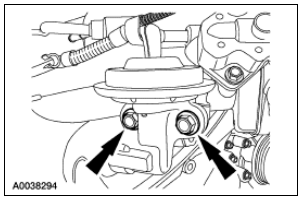
141. Install the accelerator cable clip and the nut.



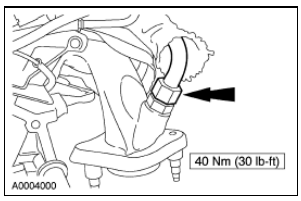
142. Install the upper intake support bracket bolt.



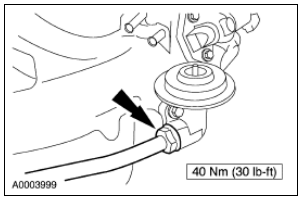
143. Loosen the exhaust gas recirculation (EGR) valve bolts.



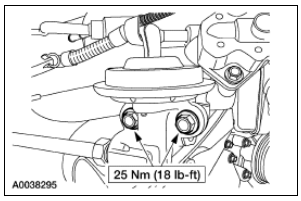
144. Connect the EGR tube at the exhaust manifold.



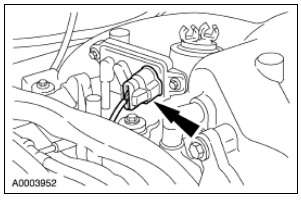
145. Connect the EGR tube to the EGR valve.



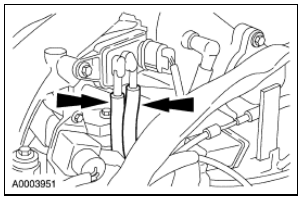
146. Tighten the EGR valve bolts.



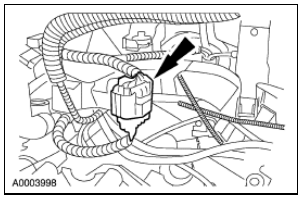
147. Connect the differential pressure feedback EGR electrical connector.



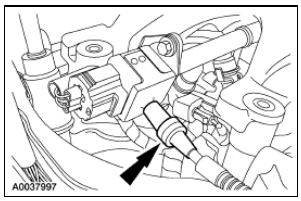
148. Connect the differential pressure feedback EGR vacuum hoses.



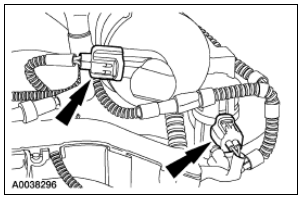
149. Connect the fuel injector wiring harness connector.



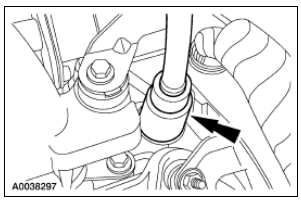
150. Connect the vacuum hose to the fuel pressure sensor.



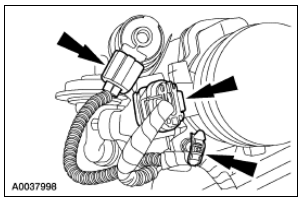
151. Connect the intake manifold tuning valve electrical connector and the EGR vacuum regulator control electrical connector.



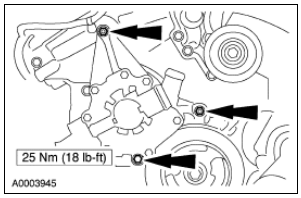
152. Install the PCV valve and tube.



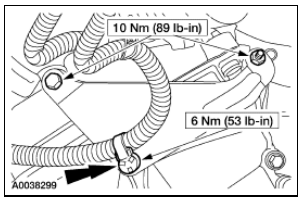
153. Connect the idle air control (IAC) valve and throttle position (TP) sensor electrical connectors. Attach the wiring retainer to the throttle body stud.



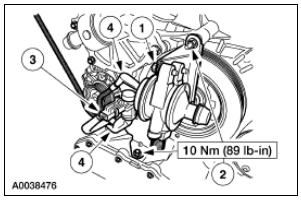
154. Position the water pump and install one bolt and two studs.



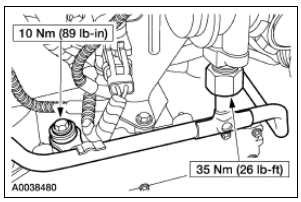
155. Install the bracket.



156. If equipped, install the thermactor air control valve and bracket.
    1. Install the valve and bracket.
    2. Install the nut and bolt.
    3. Connect the electrical connector.
    4. Connect the vacuum connector.

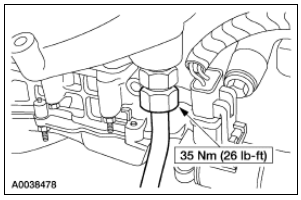


157. Install the thermactor tube and install the bolt.

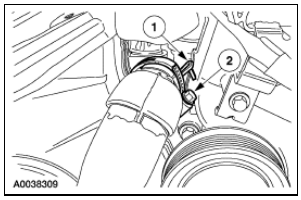


158. **NOTE:** Right side shown, left side similar.

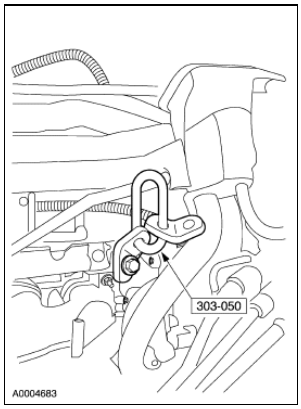
    Connect the thermactor tube at the exhaust manifolds.



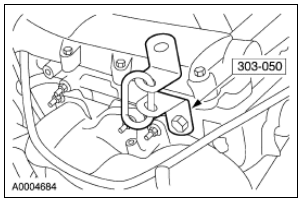
159. Connect the water pump hose.
    1. Compress the constant tension clamp and install the water pump hose.
    2. Tighten the screw-type clamp.



160. Install the special tool onto the engine as shown.

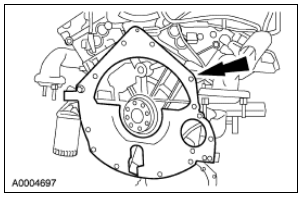


161. Install the special tool onto the engine as shown.



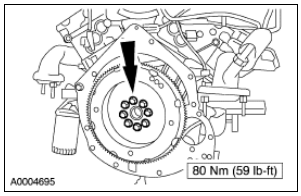
162. Using the special tool and an engine crane, transfer the engine from the stand to the floor or a bench.

163. Install the rear cover plate assembly.

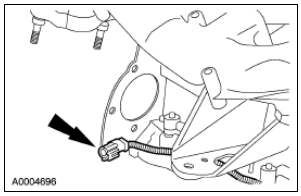


164. **NOTE:** If equipped with manual transmission, install the clutch assembly. For additional information, refer to Section 308-01 .

Install the flywheel and the bolts.

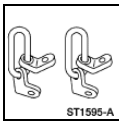


165. Attach both the wiring harness retainers, one on each side of the engine.


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Engine

Special Tool(s)

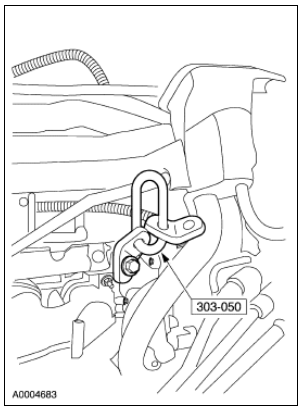
 ST1595-A	Engine Lifting Brackets 303-050

Material

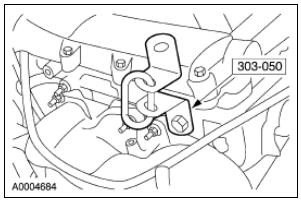
Item	Specification
Super Premium SAE 5W-20 Motor Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

All vehicles

1. Install the special tool to the engine as shown.

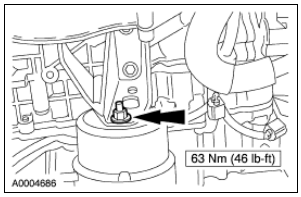


2. Install the special tool to the engine as shown.

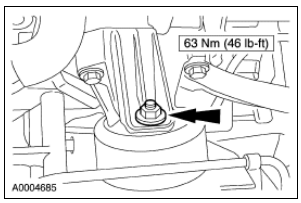


3. Using an engine crane, transfer the engine to the subframe.

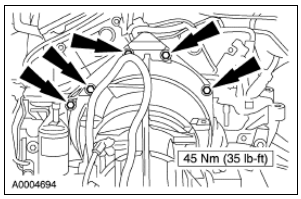
4. Install the RH engine mount nut.



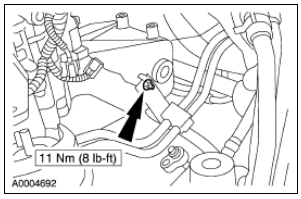
5. Install the LH engine mount nut.



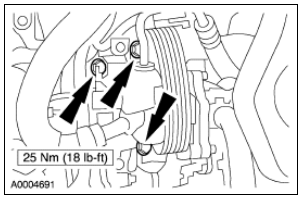
6. Install the transmission to the engine and install the bolts.



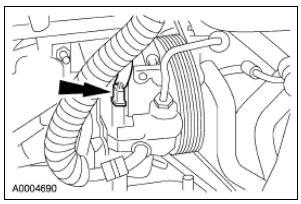
7. If equipped, position the transmission oil cooler lines to the oil pan and install the nut.



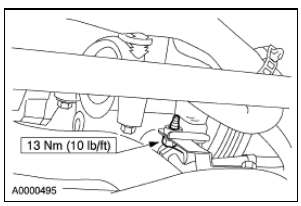
8. Position the hydraulic cooling fan pump and install the bolts.



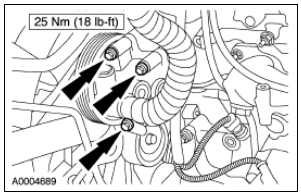
9. Connect the hydraulic cooling fan pump electrical connector.



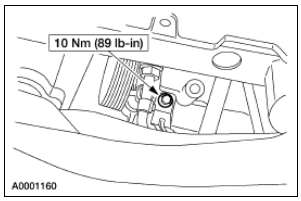
10. Install the hydraulic cooling fan high pressure tube bracket and retaining bolt.



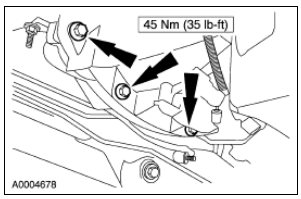
11. Position the power steering pump and install the bolts.



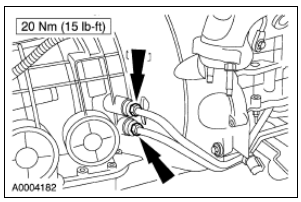
12. Install the power steering high pressure tube bracket and retaining bolt.



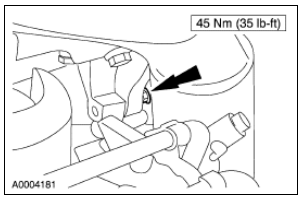
13. Install the four lower engine-to-transmission bolts.



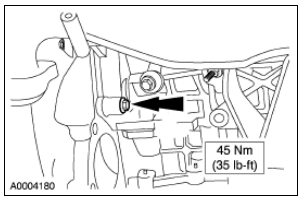
14. If equipped, connect the transmission oil cooler lines.



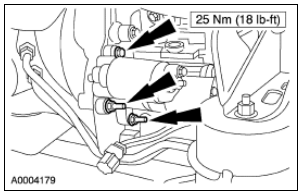
15. Install the transmission-to-engine bolt.



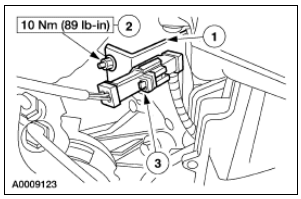
16. Install the transmission-to-engine bolt.



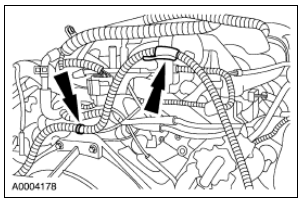
17. Position the starter and install the studs and bolt.



18. Install the heated oxygen sensor (HO2S) bracket.
    1. Position the bracket.
    2. Install the nut.
    3. Clip the connector onto the bracket.

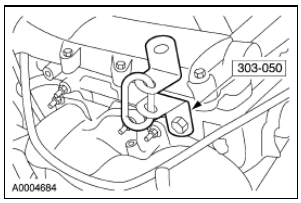


19. Position the wiring harness and attach the two harness retainers.

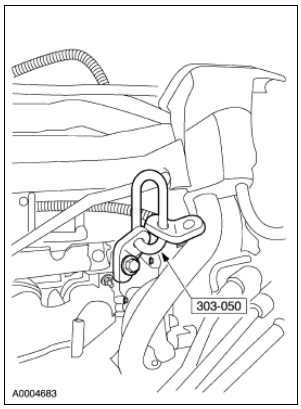


20. Remove the lifting equipment.

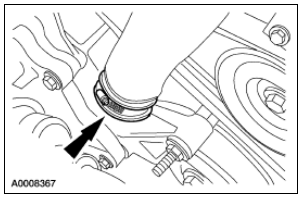
21. Remove the special tool.



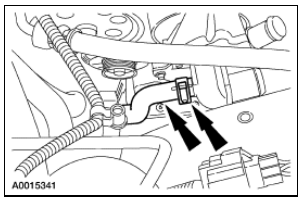
22. Remove the special tool.



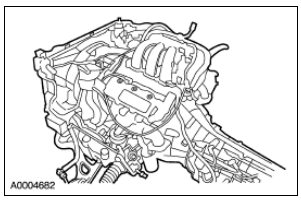
23. Connect the upper radiator hose to the water pump and the water outlet tube.



24. Connect the heater hose to the water pump.

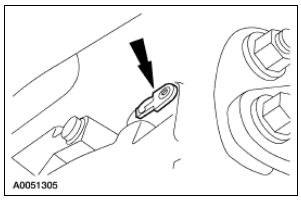


25. Position and carefully raise the entire engine, transmission, cooling and subframe assembly into the vehicle.

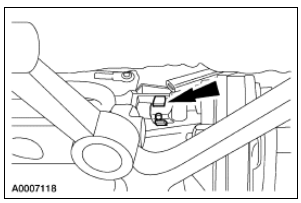


Vehicles with manual transmission

26. Connect the stabilizer shifter rod.

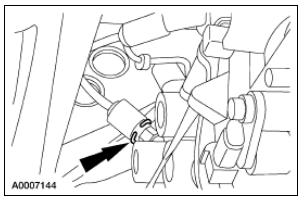


27. Connect the shifter selector rod.



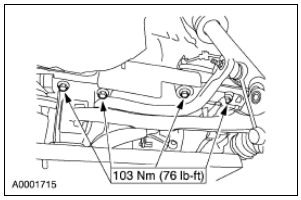
28. **NOTE:** Install a new O-ring seal and clip to the supply tube.

    Connect the slave cylinder supply tube.

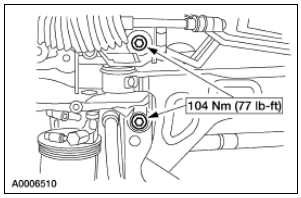


All vehicles

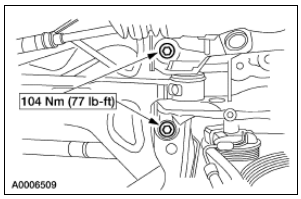
29. Install the crossmember bolts.



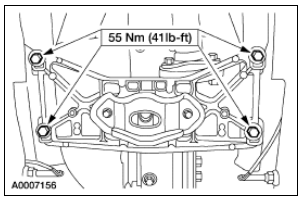
30. Install the RH subframe bolts.



31. Install the LH subframe bolts.



32. Install the transmission support bracket.



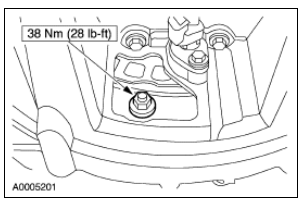
33. Remove the powertrain lift and transmission support bracket.

34. Remove the safety stands from the rear of the vehicle.

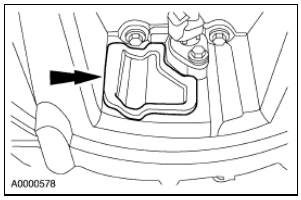
Vehicles with automatic transmission

35. **NOTE:** Align the reference marks made during removal.

    Install the nuts.

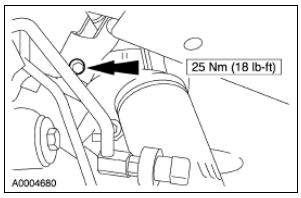


36. Install the access cover.

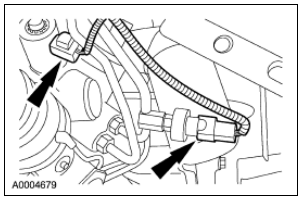


All vehicles

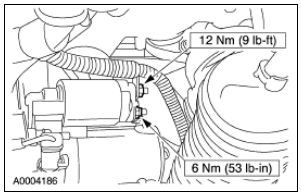
37. Install the steering shaft clamp bolt.



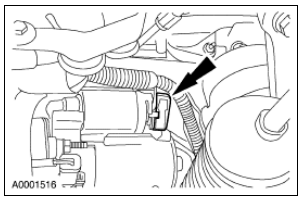
38. Connect the two power steering pressure electrical connectors.



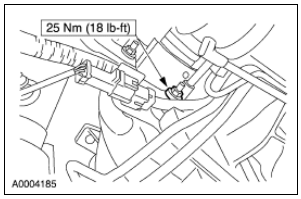
39. Connect the starter wiring.



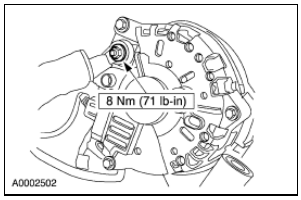
40. Install the starter wiring cover.



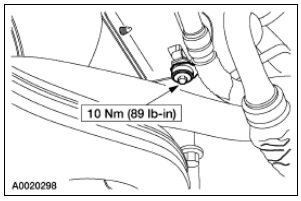
41. Connect the ground wire.



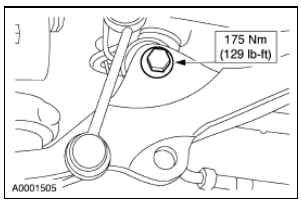
42. Connect the B+ terminal to the generator.



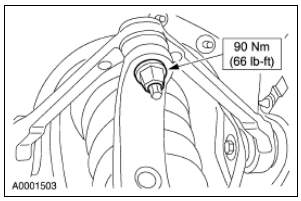
43. Install the power steering tube bracket to the LH frame rail.



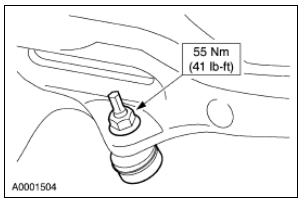
44. Install the lower strut mount bolts.



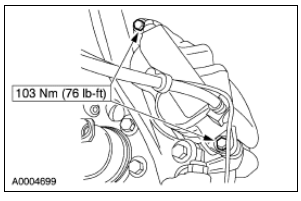
45. Install the upper ball joint nut.



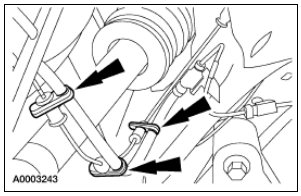
46. Connect the stabilizer link lower mounts and install the nuts.



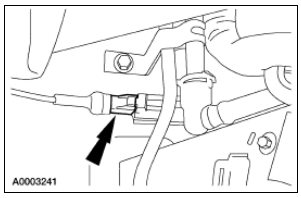
47. Install the front brake calipers.



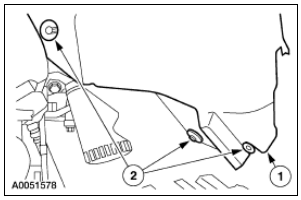
48. Connect the anti-lock brake sensor harness to the brake hose clips.



49. Connect the anti-lock brake sensor electrical connector.



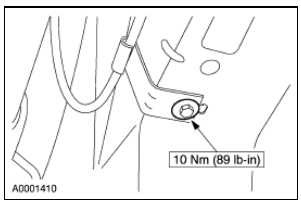
50. Install the inner splash shield.
    1. Position the inner splash shield in the installed position.
    2. Install the pin-type retainers.



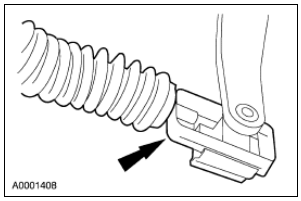
51. Install the front wheels and tires. For additional information, refer to Section 204-04 .

Vehicles with automatic transmission

52. Position the cable bracket and install the bolt.

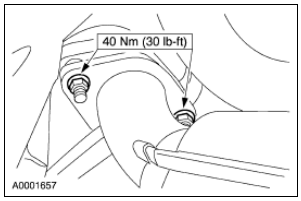


53. Connect the shift cable to the transmission. For cable adjustment, refer to Section 307-05 .

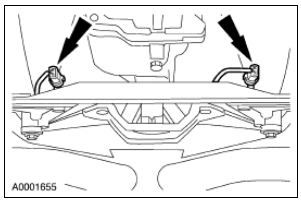


All vehicles

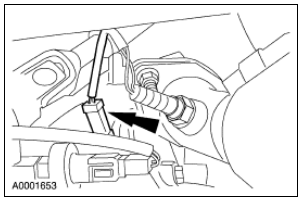
54. Install the three-way catalytic converter and the four nuts.



55. Connect the two catalyst monitor connectors.

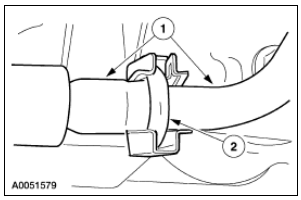


56. Connect the two oxygen sensor electrical connectors.

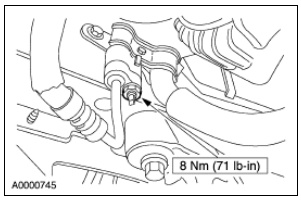


57. Install the driveshaft. For additional information, refer to Section 205-01 .

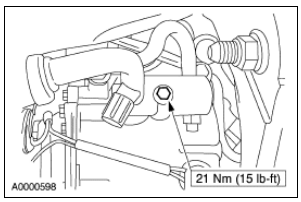
58. Connect the A/C suction tube.
    1. Connect the A/C tube.
    2. Install the safety clip.



59. Connect the A/C high pressure tube at the right frame rail.



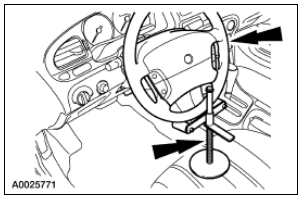
60. Position the A/C manifold assembly and install the bolt.



61. Install the center, LH and RH splash shields.

62. Lower the vehicle.

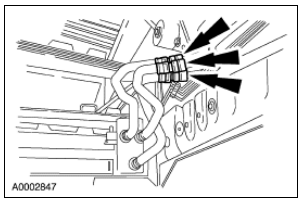
63. Remove the tool holding the steering wheel.



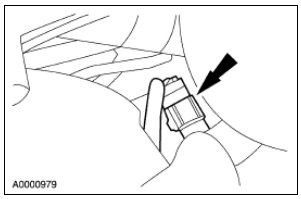
64. **NOTE:** The top heater hose has a green identifying mark to match the hose on the dual coolant flow valve. If the mark is not visible, identify the hoses for location. This will aid in the correct installation of the hose assemblies.

    NOTE: Hose assemblies shown with components removed for clarity.

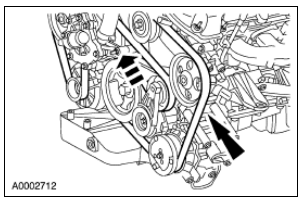
    Connect the three quick-disconnect couplings from the coolant control valve hoses. For additional information, refer to Section 412-00 .



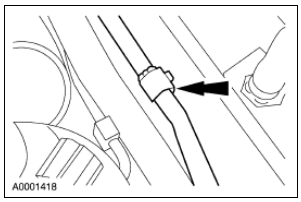
65. Connect the connector located at the end of the coolant valve harness pigtail.



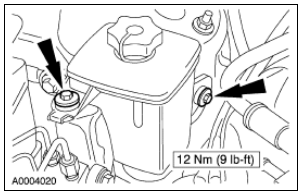
66. Install the front end accessory drive belt.



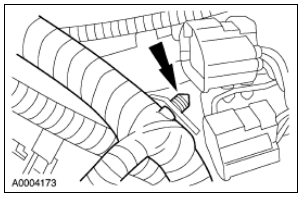
67. Attach the line to the frame.



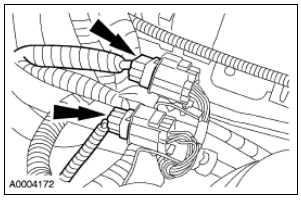
68. Position the hydraulic cooling fan reservoir and install the bolts.



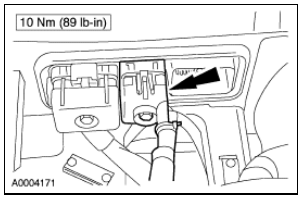
69. Attach the two wiring harness retainers to the bracket.



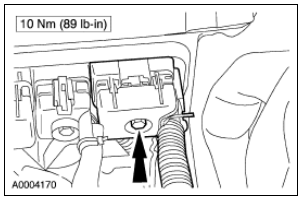
70. Connect the two fuel charging wiring harness electrical connectors.



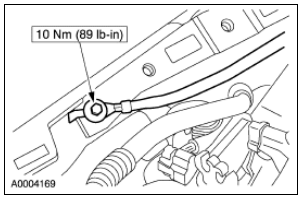
71. Connect the main transmission wiring harness connector and tighten the bolt.



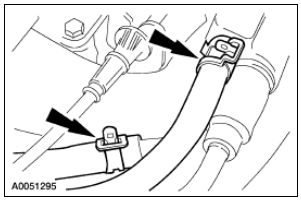
72. Connect the main engine wiring harness connector and tighten the bolt.



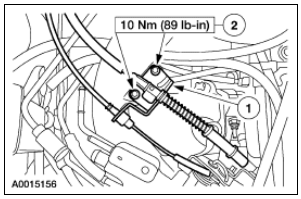
73. Install the ground strap bolt.



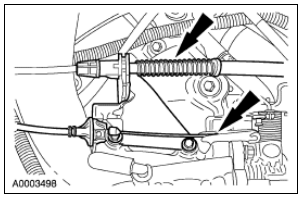
74. Connect the throttle body coolant hoses.



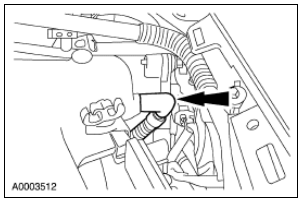
75. Install the cable bracket.
    1. Install the bracket.
    2. Install the bolts.



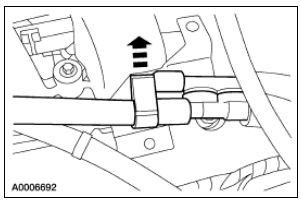
76. Connect the throttle and speed control cables.



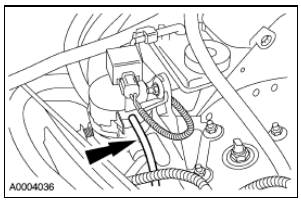
77. Connect the main vacuum hose to the rear of the upper intake manifold.



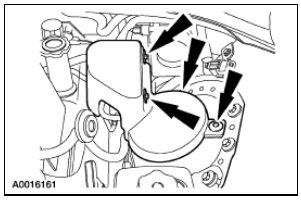
78. Connect the chassis vacuum lines and clip into the support bracket.



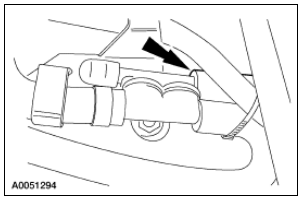
79. Connect the vacuum hose.



80. Install the vapor management valve (VMV) cover.

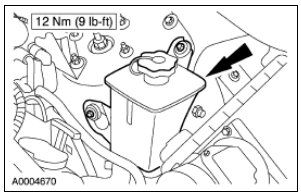


81. Connect the brake booster vacuum hose.

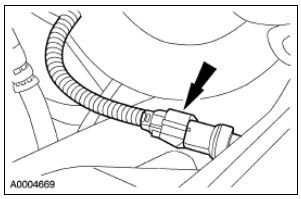


82. Connect the fuel tube spring lock coupling. For additional information, refer to Section 310-00 .

83. Position the steering reservoir and install the bolts.

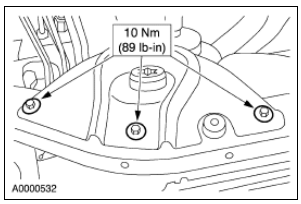


84. Connect the A/C pressure switch.

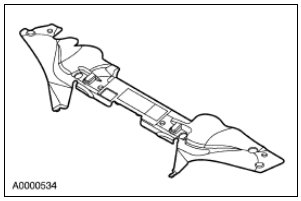


85. **NOTE:** Right side shown; left side similar.

Install the upper radiator support brackets.

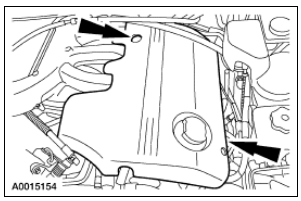


86. Install the upper radiator sight shield.



87. Install the air cleaner and air cleaner outlet tube. For additional information, refer to Section 303-12 .

88. Install the engine appearance cover.



89. Connect the battery ground cable. For additional information, refer to Section 414-01 .

90. Install the fresh air inlet duct. For additional information, refer to Section 412-01 .

91. Fill engine with clean engine oil.

92. Fill and bleed power steering system. For additional information, refer to Section 211-00 .

93. Fill and bleed hydraulic cooling fan system. For additional information, refer to Section 303-03 .

94. Fill the cooling system. For additional information, refer to Section 303-03 .

95. Evacuate and charge the A/C system. For additional information, refer to Section 412-00 .

96. Check front end alignment. For additional information, refer to Section 204-00 .

General Specifications

Item	Specification
Lubricants and Sealants	
SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP	WSS-M2C153-H
Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10)	ESE-M97B44-A
Motorcraft Premium Gold Engine Coolant VC-7-A	WSS-M97B51-A1
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Engine	
Engine oil capacity (with filter change)	5.7 Liters (6.0 Quarts)

Torque Specifications

Description	Nm	lb-ft	lb-in
Intake manifold bolts	25	18	
Throttle body bolts	9		80
Thermostat housing bolts	9		80
EVR solenoid bolts	6		53
EGR valve bolts	25	18	
EGR valve to exhaust manifold tube nuts	40	30	
Engine compartment brace bolts	9		80
Valve cover bolts	10		89
Fuel line bracket bolt	11		97
Oil level indicator tube nut	6		53
Power steering pump reservoir upper bolt	6		53
Power steering pump reservoir lower bolt	12		106
Wiring harness bolts	11		97
Ignition coil bolts	5		44
Coil cover bolts	5		44
Evaporative emission purge valve bracket nuts	10		89
Wiring harness nuts	11		97
Cylinder head bolts	[a]		
Fresh air box nuts	10		89
Fresh air duct nuts	10		89

Wiring harness bracket bolts	5		44
Hydraulic cooling fan reservoir upper bolt	6		53
Hydraulic cooling fan reservoir lower bolt	12		106
EGR tube bracket bolts	11		97
Crankshaft pulley bolt	a		
Idler pulley bolts	25	18	
Engine front cover bolts	a		
Power steering pump bracket bolts	25	18	
Hydraulic cooling fan pump bracket bolts	25	18	
Power steering pressure hose nuts	20	15	
Lower radiator hose bolts	10		89
Water pump bolts	a		
Water pump pulley bolts	a		
Timing chain tensioner bolts	11		97
Camshaft sprocket bolts	a		
Timing chain guide bolts	11		97
Timing chain tensioner arm bolts	11		97
Crankshaft position sensor bolt	10		89
Camshaft bearing cap bolts	a		
Exhaust manifold bolts	25	18	
Exhaust manifold to catalytic converter nuts	40	30	
Camshaft position sensor bolt	11		97
Cylinder head temperature sensor	11		97
Power steering pump bolts	25	18	
Oil filter	b		
Oil filter adapter bolts	25	18	
Oil pan bolts	a		
Oil pan drain plug	23	17	
Oil pump bolts	12	9	
Oil pump screen cover and tube bolts	12	9	
Flexplate spacer nuts	38	28	
Engine mount to frame bolts	40	30	
Engine mount bracket to cylinder block bolts	46	34	
Upper to lower cylinder block bolts	a		
Connecting rod cap bolts	a		
Oil sump bolts	a		
Knock sensor bolts	20	15	
Oil pan bolts	a		
Heated oxygen sensor bracket bolts	6		53
Generator bolts and nut	a		
Transmission to engine bolts	47	35	
Transmission wiring harness nuts	10		89
Power steering hose bracket bolt	10		89
Transmission cooler tube nuts	35	26	

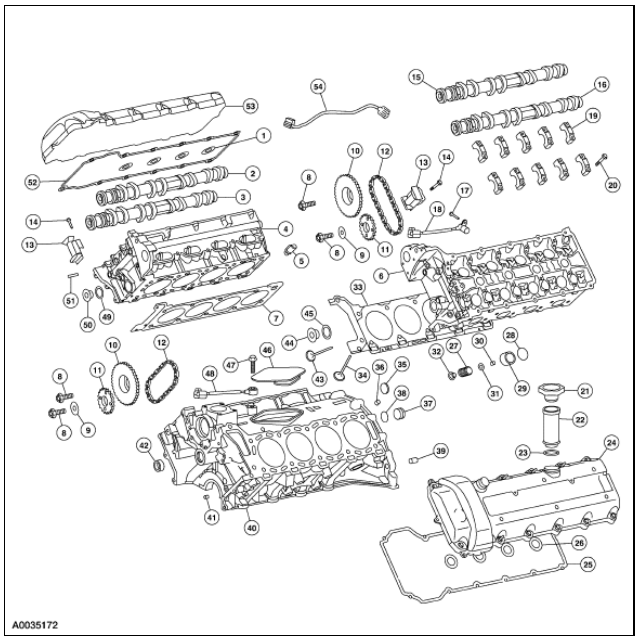
Cowl panel support bracket bolts	9		80
A/C compressor bracket bolts	25	18	
A/C compressor bolts	25	18	
Water crossover bolts	11		97
Oil cooler assembly	25	18	
A/C high pressure hose	8		71
Starter bracket nut	10		89
A/C manifold nut	21	15	
Subframe bolts	103	76	
Steering coupling bolt	35	26	
Cooling fan hose bracket bolt	10		89
Lower strut mount bolts	175	129	
Upper ball joint nuts	90	66	
Stabilizer bar link nuts	55	41	
Starter motor wiring harness nut	6		53
Oil cooler bolts	58	43	
Shift cable bracket bolt	10		89
Heater hose bracket bolt	10		89
Ground strap bolt	10		89
Radiator support bracket bolts	10		89
Cylinder block flanged plug	20 + 10 degrees	15 + 10 degrees	
Water jacket plug	25	18	
M30 cylinder block plugs	50	37	
EGR heat shield bolts	10		89
EGR valve adapter bolts	10		89
Radio interference capacitor nuts	6		53
Inlet tube support bracket bolts	11		97
Drive belt tensioner bolt	50	37	

[a] Refer to procedure for staged torque.

[b] Install the oil filter until the seal makes contact. Tighten an additional 270 degrees.

Engine

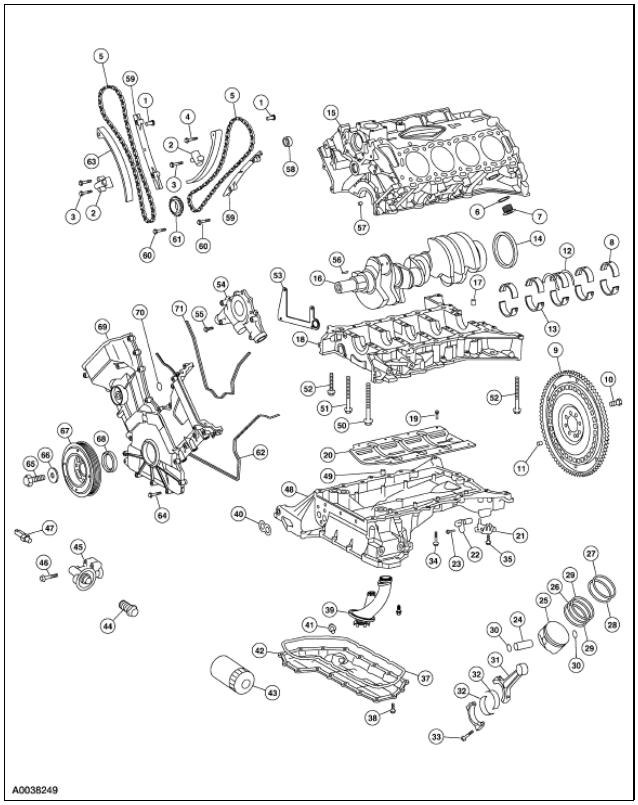
Cylinder Head and Valve Train



Item	Part Number	Description
1	12A409	Valve cover gaskets (4 req'd)
2	6A270	Camshaft, intake, RH
3	6A272	Camshaft, exhaust, RH
4	6049	Cylinder head, RH
5	6G004	Cylinder head temperature sensor, RH
6	6050	Cylinder head, LH
7	6051	Head gasket, RH
8	W701512	Bolt (4 req'd)
9	W704842	Washer (2 req'd)
10	6256	Intake camshaft sprocket (2 req'd)
11	6C258	Exhaust camshaft sprocket (2 req'd)
12	6268	Secondary timing chain (2 req'd)
13	6B209	Secondary timing chain tensioner
14	W500302	Bolt (4 req'd)
15	6A271	Camshaft, intake, LH
16	6A273	Camshaft, exhaust, LH
17	W500214	Bolt
18	6B288	Camshaft position sensor
19	6A258	Camshaft bearing cap (20 req'd)
20	W701242	Bolt (40 req'd)
21	6766	Oil filler cap
22	6765	Oil filler tube

23	W705327	Seal
24	6P053	Valve cover, LH
25	6P054	Valve cover gasket, LH
26	12A409	Valve cover gasket, LH (4 req'd)
27	6513	Valve spring (32 req'd)
28	6K514	Valve shim (32 req'd)
29	6500	Bucket (32 req'd)
30	6518	Valve keeper key (64 req'd)
31	2762	Valve keeper (32 req'd)
32	6A536	Valve seal (32 req'd)
33	6083	Head gasket, LH
34	6507	Intake valve (16 req'd)
35	W528009	Cup plug (2 req'd)
36	W701705	Dowel (4 req'd)
37	W704848	Flanged plug
38	W703346	Sealing washer
39	6397	Dowel (2 req'd)
40	6L074	Cylinder block assembly
41	6L002	Dowel (2 req'd)
42	W703302	Pipe plug
43	6505	Exhaust valve
44	W704848	Flanged plug
45	W703346	Sealing washer
46	6L033	Valley plug
47	W500310	Bolt (2 req'd)
48	12A699	Knock sensor (2 req'd)
49	W703346	Sealing washer
50	W704848	Flanged plug
51	6K253	Dowel (2 req'd)
52	6K260	Valve cover gasket, RH
53	6P040	Valve cover, RH
54	14B102	Jumper harness

Lower End

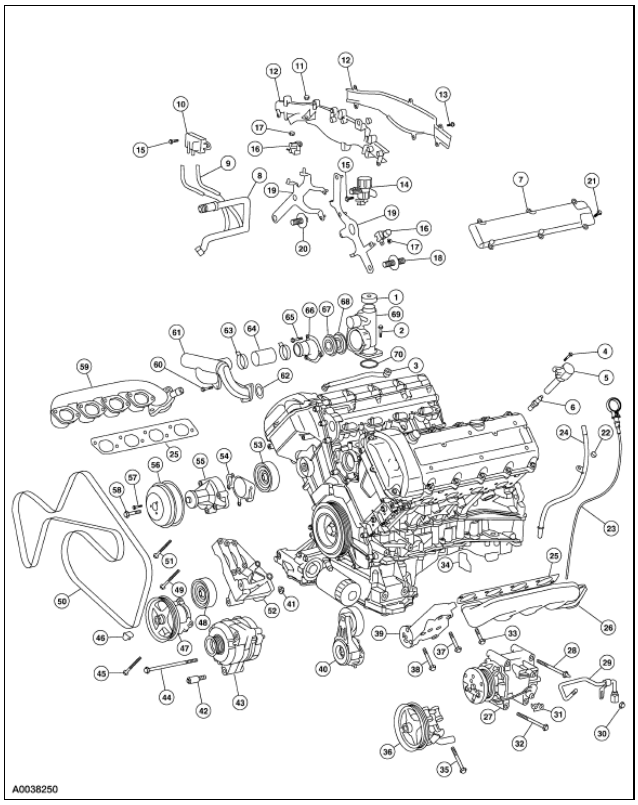


Item	Part Number	Description
1	6P044	Sleeve (2 req'd)
2	6K254	Primary timing chain tensioner (2 req'd)
3	W500302	Bolt (4 req'd)
4	W701973	Bolt (2 req'd)
5	6268	Primary timing chain (2 req'd)
6	W703346	Sealing washer
7	W704846	Flanged plug
8	6333	Upper crankshaft bearing (5 req'd)
9	6K375	Flexplate
10	W704862	Bolt (8 req'd)
11	6253	Dowel
12	6308	Thrust washer (2 req'd)
13	6331	Lower crankshaft bearing (5 req'd)
14	6701	Crankshaft rear main seal
15	6L074	Cylinder block assembly
16	6303	Crankshaft
17	W701705	Dowel (10 req'd)
18	6L074	Cylinder block assembly
19	W500203	Bolt (8 req'd)
20	6L712	Oil pan baffle
21	14W163	Heated oxygen sensor bracket (2 req'd)
22	6C315	Crankshaft position sensor
23	W500214	Bolt
24	6135	Piston pin (8 req'd)

25	6110	Piston (8 req'd)
26	6161	Spacer/expander ring (8 req'd)
27	6150	Compression ring, Upper (8 req'd)
28	6152	Compression ring, Lower (8 req'd)
29	6152	Oil control ring, (16 req'd)
30	6140	Snap ring (16 req'd)
31	6200	Connecting rod (8 req'd)
32	6211	Connecting rod bearing (16 req'd)
33	6214	Bolt (16 req'd)
34	W704749	Bolt (16 req'd)
35	W701504	Bolt (2 req'd)
36	W500305	Bolt (3 req'd)
37	6B638	Oil pan gasket
38	W701504	Bolt (17 req'd)
39	6617	Oil pump screen cover and tube
40	6840	Gasket
41	W704995	Oil drain plug
42	6695	Oil pan assembly
43	6714	Oil filter
44	6884	Oil filter fitting
45	6A644	Oil filter adapter
46	W704816	Bolt (3 req'd)
47	9278	Oil pressure sensor
48	6C674	Upper sump assembly
49	6C002	Dowel
50	6345A	Bolt (10 req'd)
51	6345B	Bolt (12 req'd)
52	6345C	Bolt (12 req'd)
53	6659	Oil pump gasket
54	6600	Oil pump
55	W500304	Bolt (4 req'd)
56	W704975	Woodruff key
57	6C002	Dowel (2 req'd)
58	W703302	Pipe plug
59	6K297	Timing chain guide (2 req'd)
60	W500302	Bolt (2 req'd)
61	6306	Crankshaft timing chain sprocket (2 req'd)
62	6E009	Front cover gasket (outer)
63	6L266	Timing chain tensioner arm
64	W704751	Bolt (24 req'd)
65	W705542	Bolt
66	W704965	Washer
67	6316	Crankshaft pulley
68	6700	Front cover seal

69	6059	Engine front cover assembly
70	6D081	Idler pulley seal
71	6C075	Front cover seal (inner)

Lower End Exterior Dress

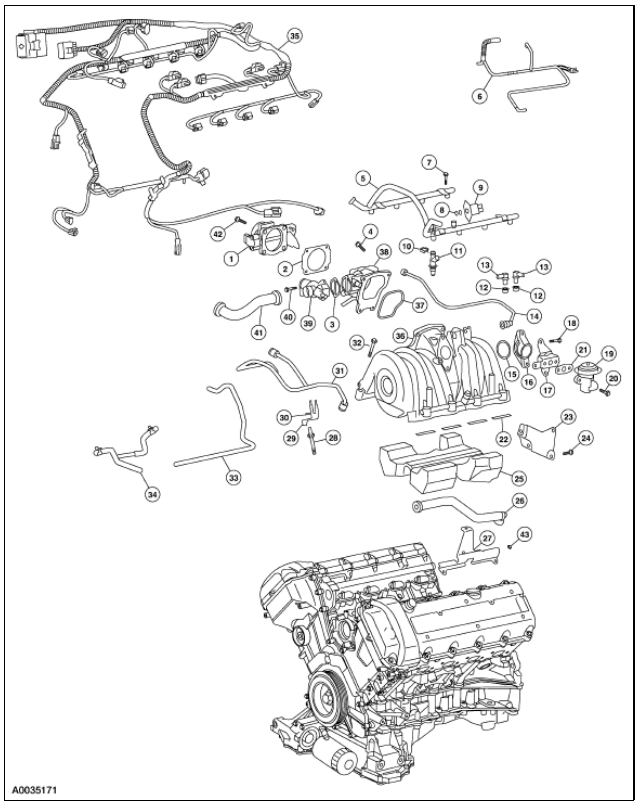


Item	Part Number	Description
1	8A511	Thermostat housing cap
2	W500215	Bolt (4 req'd)
3	6C342	Breather hose part load
4	W500205	Bolt (8 req'd)
5	12A366	Ignition coil (8 req'd)
6	12405	Spark plug (8 req'd)
7	12025	Coil cover (2 req'd)
8	9D477	EGR valve to exhaust manifold tube
9	9P761	EGR valve to exhaust manifold vacuum line (2 req'd)
10	9J460	Differential pressure feedback EGR assembly
11	W700430	Nut (2 req'd)
12	14W163	Wire harness channel and cover
13	W500202	Bolt (6 req'd)
14	9J459	EGR vacuum regulator solenoid
15	W500202	Bolt (4 req'd)
16	18801	Radio ignition interference capacitor (2 req'd)
17	W705035	Nut (1 req'd)
18	W520411	Stud bolt
19	14W163	Wiring harness bracket (2 req'd)

20	W705036	Bolt
21	W500205	Bolt (12 req'd)
22	W520411	Nut
23	6752	Oil level indicator
24	6754	Oil level indicator tube
25	9448	Exhaust manifold gasket (2 req'd)
26	9431	Exhaust manifold, LH
27	19D629	A/C compressor
28	W705060	Stud bolt
29	3E576	Jumper tube
30	W520412	Nut
31	3R801	Bracket
32	W704750	Bolt (3 req'd)
33	W701240	Bolt (16 req'd)
34	7N840	Flexplate inspection cover
35	W704752	Bolt (4 req'd)
36	3A696	Power steering pump
37	W500315	Bolt (3 req'd)
38	W704752	Bolt (2 req'd)
39	3K738	PAS bracket
40	6B209	Drive belt tensioner
41	W520414	Nut
42	W70539	Bolt and bushing assembly
43	10300	Generator
44	W704756	Bolt
45	W704752	Bolt (4 req'd)
46	3R801	Bracket
47	8C648	Hydraulic cooling fan pump
48	19A216	Idler pulley, flanged
49	W704752	Bolt (2 req'd)
50	8620	Drive belt
51	W500315	Bolt (3 req'd)
52	3D743	Hydraulic cooling fan pump bracket
53	19A216	Idler pulley, non-flanged
54	8507	Water pump gasket
55	8501	Water pump
56	8509	Water pump pulley
57	W705629	Bolt (3 req'd)
58	W500304	Bolt (5 req'd)
59	9430	Exhaust manifold, RH
60	W500215	Bolt (4 req'd)
61	8A520	Water outlet pipe assembly
62	8255	O-ring seal
63	W525972	Clamp (2 req'd)

64	9F287	Hose
65	W500014	Bolt (3 req'd)
66	8594	Thermostat housing cover
67	8575	Thermostat
68	8A571	O-ring seal
69	8K515	Thermostat housing
70	9K462	O-ring seal

Upper End Exterior Dress



Item	Part Number	Description
1	9E926	Throttle body
2	9E936	Throttle body gasket
3	9F670	Idle air control valve gasket
4	W701662	Bolt (4 req'd)
5	9S441	Fuel injection supply manifold
6	9E498	Vacuum harness
7	W500013	Bolt (4 req'd)
8	W705818	O-ring seals (2 req'd)
9	9F972	Fuel pressure sensor
10	9N976	Clip (8 req'd)
11	9F593	Fuel injector (8 req'd)
12	9H490	Seal (2 req'd)
13	9S497	Stub pipe (2 req'd)
14	9D289	Purge hose
15	6L438	Seal

16	9H450	EGR flange
17	9P962	EGR valve adapter
18	W701568	Bolt (3 req'd)
19	9D460	Exhaust recirculation valve
20	N807843	Bolt (2 req'd)
21	9D476	EGR valve gasket
22	9439	Intake manifold gasket (8 req'd)
23	9Y426	Heat shield
24	W500211	Bolt (4 req'd)
25	6N041	Noise insulator
26	9K617	Crankcase ventilation hose
27	6N081	Bracket
28	W705479	Stud bolt
29	14536	Bracket
30	W520411	Nut
31	9P903	Air assist hose
32	W500313	Bolt (9 req'd)
33	9F814	Throttle body heater return hose
34	9F813	Throttle body heater feed hose
35	12B637	Engine sensor control wiring harness
36	9425	Intake manifold
37	6C653	Throttle body adapter gasket
38	9632	Throttle body adapter
39	9F715	Idle air control valve
40	W701662	Bolt (2 req'd)
41	9P903	Air assist tube
42	W701568	Bolt (4 req'd)
43	W520411	Nut (2 req'd)

Identification

For quick identification refer to the safety certification decal.

- The decal is located on the LH front door lock face panel.
- Find the engine code (letter or number) on the decal, then refer to the Engine Identification Chart to determine engine type and size. For additional information, refer to Section 100-01 .
- The symbol code on the identification tag identifies each engine for determining parts usage; for example, engine displacement in liters or cubic inch displacement and model year.

Engine Code Information

The engine code information label is located on the valve cover. The label contains, among other information:

- the engine calibration number
- the engine build date
- the engine plant code
- the engine code

Emission Calibration Label

NOTE: The engine codes and the calibration numbers must be used when making inquiries or ordering parts.

The emission calibration number label is located on the LH side door or LH door post pillar. It identifies:

- the engine calibration number
- the engine code number
- the revision level

These numbers are used to determine if parts are unique to specific engines.

Exhaust Emission Control System

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Induction System

The air/fuel mixture needed for burning in the cylinders is provided by the multiport fuel injection (MFI) system. Refer to Section 303-04B for additional information.

Fuel is:

- supplied from the fuel tank by the fuel pump.
- regulated by the fuel pressure sensor.
- delivered to the injector supply manifold.

A dual damper has been added to reduce pressure fluctuations caused by the fuel injectors.

Crankshaft

The crankshaft is supported on the bottom of the cylinder block by five steel-backed, over-plated, aluminum crankshaft main bearings.

To provide smooth engine operation, the piston crankpins are positioned to provide a power impulse every 90 degrees of crankshaft rotation. The spacing provides smooth and quiet operation.

Camshafts

The camshafts:

- are arranged in pairs, one each (intake and exhaust) on each cylinder head.
- are synchronized through a secondary timing chain.
- depress the direct acting mechanical tappets to actuate the valves.

Valve Train

The valves are actuated by a direct acting mechanical bucket and shim. The direct acting mechanical tappets and shims:

- provide lash adjustment through a shim selected by thickness.
- ride on the camshaft lobes.

Positive Crankcase Ventilation System

The engine is equipped with a positive, closed-type crankcase ventilation system which recycles the crankcase

vapors to the throttle body.

Engine Lubrication System

The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to the:

- crankshaft main bearings
- crankshaft thrust main bearing
- connecting rod bearings

All other parts are lubricated by gravity flow or splash of the oil.

Oil Pump

The rotary spur oil pump develops the oil pressure.

- The oil pump is bolted to the front of the cylinder block.
- The oil pump is rotated by the crankshaft.
- A full flow oil filter is externally mounted on the upper sump.

If the filter element becomes blocked, a spring-loaded bypass valve opens to allow uninterrupted flow of oil to the engine.

Engine Cooling System

The engine is liquid-cooled:

- by a centrifugal water pump driven by the drive belt.
- a water thermostat is used to restrict coolant flow until the engine reaches normal operating temperature.

Drive Belt System

Accessories mounted on the front of the engine are belt-driven by the crankshaft and an automatically tensioned serpentine drive belt is routed over the following components:

- water pump
- A/C compressor
- generator (GEN)
- drive belt tensioner
- drive belt idler pulley
- crankshaft pulley
- power steering pump
- hydraulic cooling fan pump

Engine

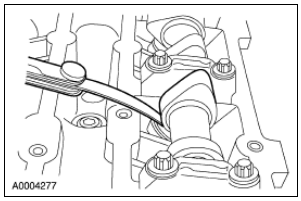
Refer to Section 303-00 .

Valve Clearance Adjustment

1. Remove the timing chains. For additional information, refer to Timing Drive Components Primary or Timing Drive Components Secondary in this section.

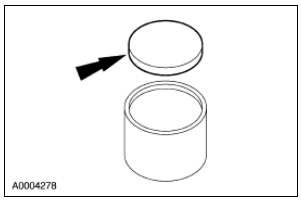
2. **NOTE:** Measure each valve clearance at base circle before removing the camshafts. The shims are not repairable with the camshafts in place. Failure to measure all clearances prior to removing the camshafts will cause unnecessary repetition of the procedure.

   Use a feeler gauge to measure each valve clearance and record its location.



3. Remove the camshafts. For additional information, refer to Camshaft in this section.

4. Remove the shims.



5. **NOTE:** The shims are marked for thickness; example: 2.22 mm = 222 on shim.

   NOTE: The corrected shims allow the following valve clearances.

   - Intake valve clearance: 0.18-0.22 mm (0.00709-0.00866 in)
   - Exhaust valve clearance: 0.23-0.27 mm (0.00906 - 0.01063 in)

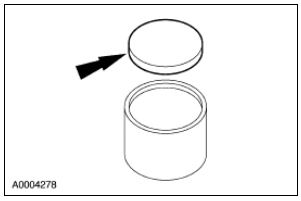
   NOTE: A midrange clearance is the most desirable:

   - Intake: 0.20 mm (0.00787 in)
   - Exhaust: 0.25 mm (0.01 in)

   NOTE: Select shims using this formula: required shim thickness = measured clearance plus the base shim thickness minus most desirable clearance.

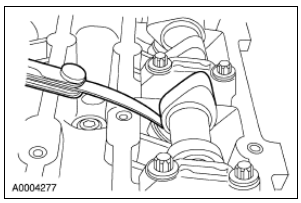
   Select shims and mark the installation location.

6. Replace the shims.



7. Install the camshaft. For additional information, refer to Camshaft in this section.

8. Measure the new valve clearances.



9. Install the timing chains. For additional information, refer to Timing Drive Components Primary or Timing Drive Components Secondary in this section.

Valve Clearance Check

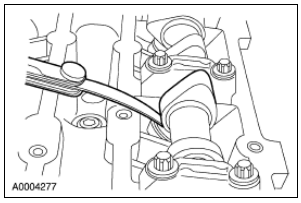
1. Remove the valve covers. For additional information, refer to Valve Cover LH or Valve Cover RH in this section.

2. Remove the spark plugs.

3. **NOTE:** The engine will have to be rotated with the crankshaft pulley bolt to bring each valve to base circle.

   NOTE: The valve clearance must be measured with the camshaft at base circle.

   Measure and record all valve clearances.



4. If the valve clearances are out of specification, refer to Valve Clearance Adjustment in this section.

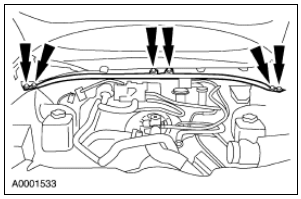
5. To assemble, reverse the inspection procedure.

Intake Manifold

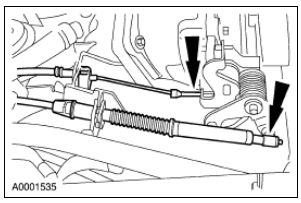
Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
3. **⚠ CAUTION: The coolant drain procedure must be followed exactly or damage to the engine can occur.**

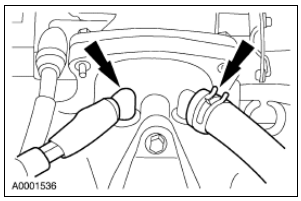
   Drain the engine cooling system. For additional information, refer to Section 303-03 .
4. Remove the cowl vent screen. For additional information, refer to Section 501-02 .
5. Remove the engine compartment brace.



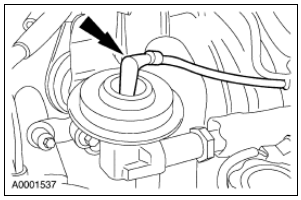
6. Disconnect the accelerator and speed control cables.



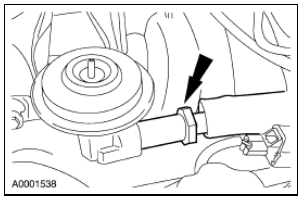
7. Disconnect the vacuum hoses.



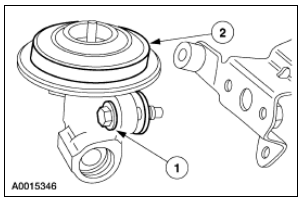
8. Disconnect the vacuum hose.



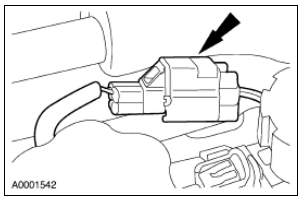
9. Disconnect the exhaust manifold to exhaust gas recirculation (EGR) valve tube.



10. Remove the EGR valve.
    1. Remove the two bolts.
    2. Remove the valve and discard the gasket.

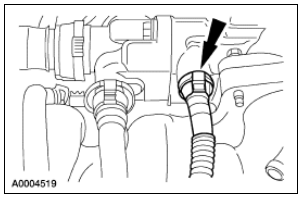


11. Disconnect the camshaft position (CMP) sensor electrical connector and separate the connector from the fuel injection supply manifold.

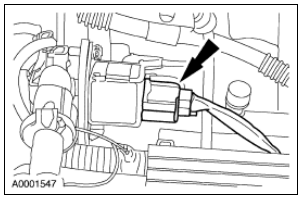


12. ⚠ **CAUTION: To remove Norma fittings, squeeze the tabs and pull straight out or damage to the fitting can occur.**

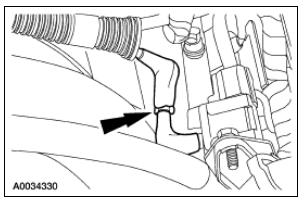
    Disconnect the evaporative emission canister purge valve hose.



13. Disconnect the fuel pressure sensor electrical connector.

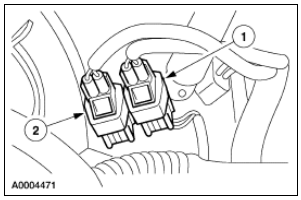


14. Disconnect the vacuum connector from the fuel pressure sensor.

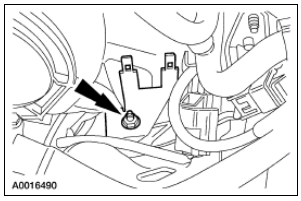


15. Disconnect the fuel line. For additional information, refer to Section 310-00 .

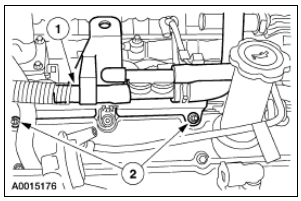
16. Remove the electrical connectors from the bracket.
    1. LH knock sensor (KS).
    2. Cylinder head temperature (CHT) sensor.



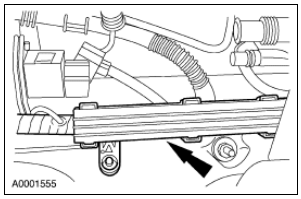
17. Remove the nut and the bracket.



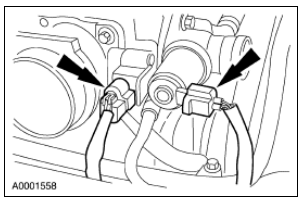
18. Remove the bracket.
    1. Remove the hose.
    2. Remove the nuts and the bracket.



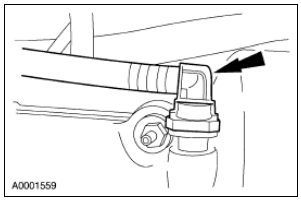
19. Raise the engine wiring harness and disconnect the LH fuel injector connectors.



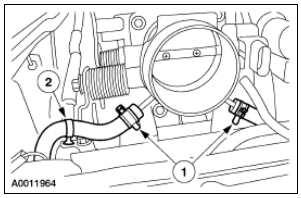
20. Disconnect the electrical connectors.
    - Idle air control (IAC) valve.
    - Throttle position (TP) sensor.



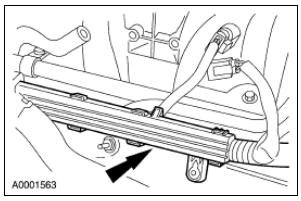
21. Disconnect the crankcase ventilation tube from the RH valve cover.



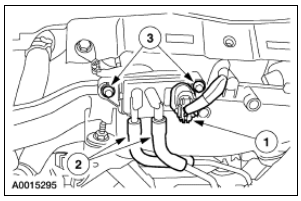
22. Disconnect the hoses.
    1. Squeeze the clamps and disconnect the hoses from the throttle body.
    2. Detach the hose from the clip.



23. Raise the engine wiring harness and disconnect the RH fuel injectors.

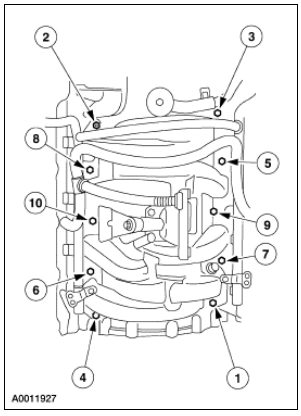


24. Remove the differential pressure feedback sensor.
    1. Disconnect the electrical connector.
    2. Disconnect the hoses.
    3. Remove the bolts and the sensor.



25. **NOTE:** The throttle body and adapter are shown removed for clarity. It is not necessary to remove the throttle body and adapter to remove the intake manifold.

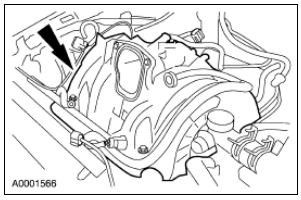
    Remove the bolts and the stud (2) in the sequence shown.



26. **NOTE:** The throttle body, adapter, and EGR valve are shown removed for clarity.

    NOTE: Position the throttle body heater return hose out of the way before removing the intake manifold.

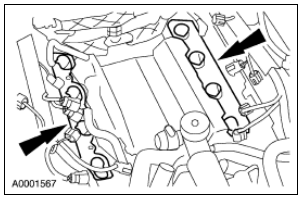
    Remove the intake manifold.



27. ⚠ **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs, or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to clean the surfaces.**

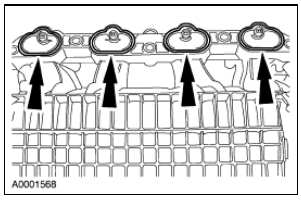
    Clean the sealing surfaces.

    - Inspect the gaskets and install new gaskets if necessary.



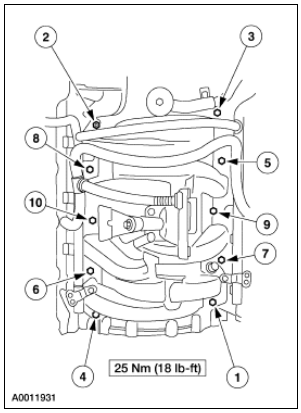
Installation

1. If removed, install the gaskets.

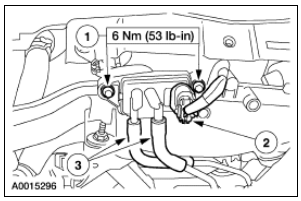


2. **NOTE:** Make sure that the throttle body heater return hose is positioned between the heat shield and the intake manifold.

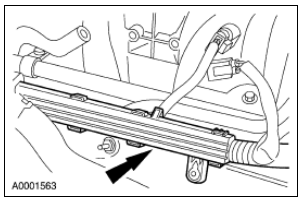
   Install the intake manifold and tighten the bolts in the sequence shown.



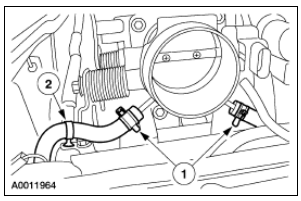
3. Install the differential pressure feedback sensor.
    1. Install the sensor and the bolts.
    2. Connect the electrical connector.
    3. Connect the hoses.



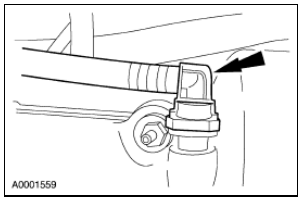
4. Connect the RH fuel injector electrical connectors, and position the engine wiring harness.



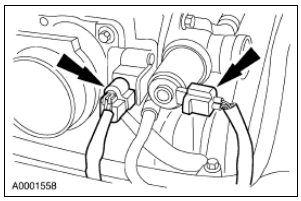
5. Connect the hoses.
    1. Connect the hoses to the throttle body and position the clamps.
    2. Attach the hose to the clip.



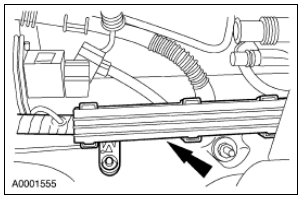
6. Connect the crankcase ventilation tube.



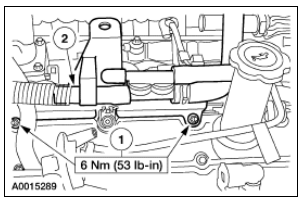
7. Connect the IAC valve and TPS electrical connectors.



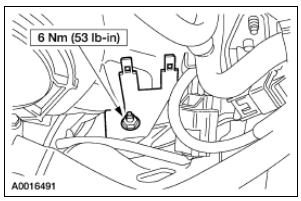
8. Connect the LH fuel injector electrical connectors and position the engine wiring harness.



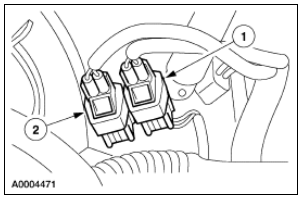
9. Install the bracket.
    1. Install the bracket and nuts.
    2. Install the hose.



10. Install the bracket and the nut.

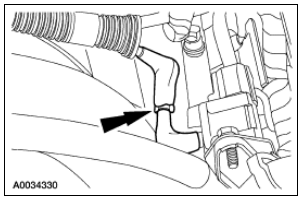


11. Install the electrical connectors on the bracket.
    1. Install the LH KS electrical connector.
    2. Install the CHT sensor electrical connector.

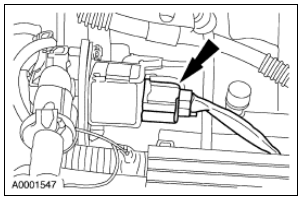


12. Connect the fuel hose. For additional information, refer to Section 310-00 .

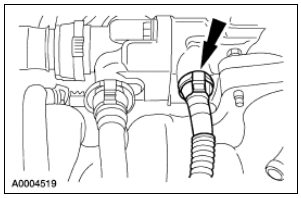
13. Connect the vacuum connector to the fuel pressure sensor.



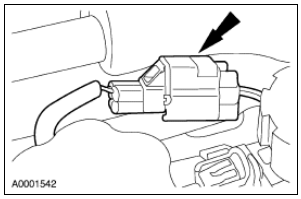
14. Connect the fuel pressure sensor electrical connector.



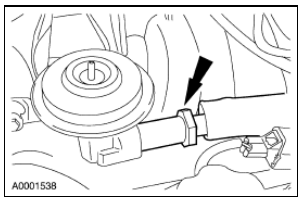
15. Connect the evaporative emission canister purge valve hose.



16. Connect the CMP sensor electrical connector, and position the connector on the fuel injection supply manifold.



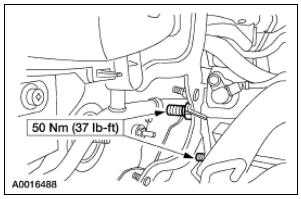
17. Connect the exhaust manifold to EGR valve tube.



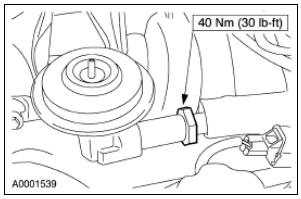
18. **NOTE:** Exhaust manifold to EGR valve tube is removed for clarity.

    Install the EGR valve.

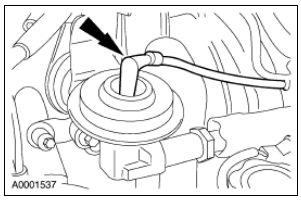
    - Install a new gasket and the valve.
    - Install the two bolts.



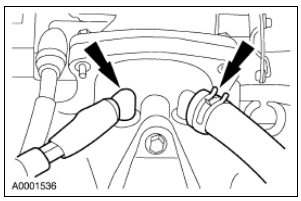
19. Tighten the tube.



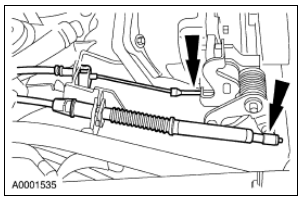
20. Connect the vacuum hose.



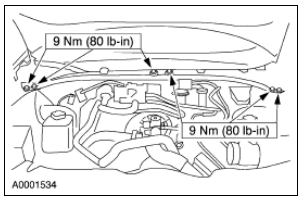
21. Connect the vacuum hoses.



22. Connect the accelerator and speed control cables.



23. Install the engine compartment brace.



24. Install the cowl vent screen. For additional information, refer to Section 501-02 .

25. Install the air cleaner outlet tube. For additional information, refer to Section 303-12 .

26. Connect the battery ground cable. For additional information, refer to Section 414-01 .

27. ⚠ **CAUTION: The cooling system filling and bleeding procedure must be followed exactly or damage to the engine can occur.**

    Fill and bleed the engine cooling system. For additional information, refer to Section 303-03 .

Valve Cover LH

Material

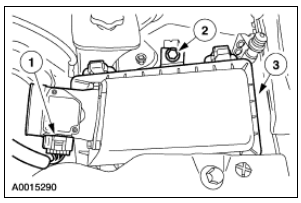
Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H
Silicone Gasket and Sealant F7AZ-19554-EA (in Canada CXC-111-B) or equivalent	WSE-M4G323-A4
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A

Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

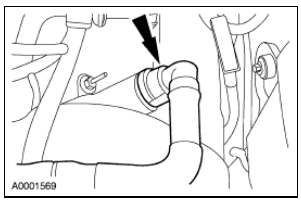
2. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .

3. Remove the air cleaner housing.
    1. Disconnect the mass air flow (MAF) sensor electrical connector.
    2. Remove the bolt.
    3. Remove the housing.



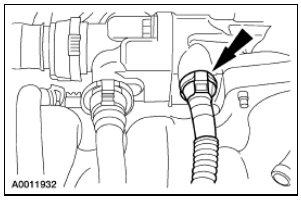
4. ⚠ **CAUTION: To disconnect the Norma fitting, squeeze the tabs and pull straight out or damage to the fitting can occur.**

    Disconnect the crankcase ventilation tube.

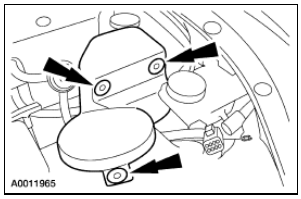


5. Disconnect the fuel hose. For additional information, refer to Section 310-00 .

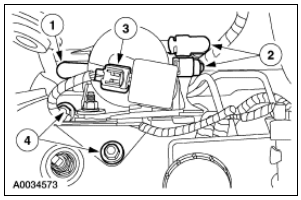
6. Disconnect the evaporative emission canister purge valve hose.



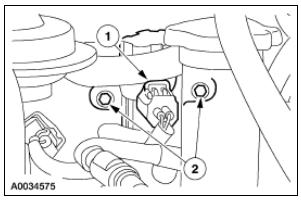
7. Remove the vapor management valve (VMV) cover.



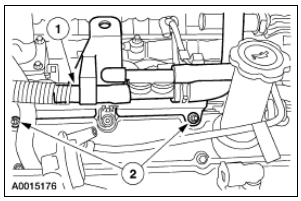
8. Remove the VMV.
    1. Disconnect the vacuum hose.
    2. Disconnect the purge hose.
    3. Disconnect the electrical connector and the push pin.
    4. Remove the nuts and the valve.



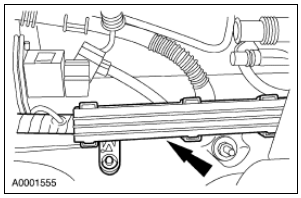
9. Remove the exhaust gas recirculation (EGR) vacuum regulator solenoid.
    1. Disconnect the electrical connector.
    2. Remove the screws and the EGR vacuum regulator solenoid.



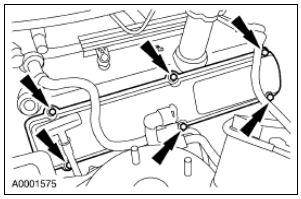
10. Remove the bracket.
    1. Remove the hose.
    2. Remove the bracket.



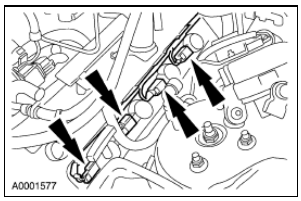
11. Position the engine wiring harness up.



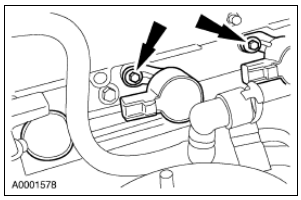
12. Remove the ignition coil cover.
    - Inspect the gasket and install a new gasket as necessary.



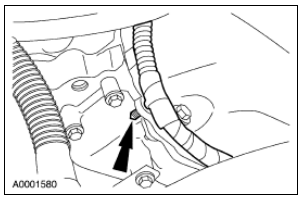
13. Disconnect the ignition coil electrical connectors.



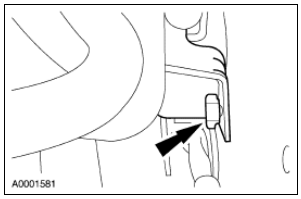
14. Remove the four LH ignition coils.



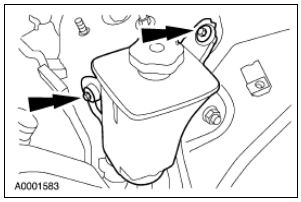
15. Disconnect the three wiring harness retainers.



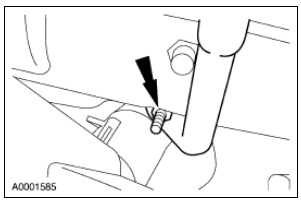
16. Remove the fuel hose bracket bolt from the LH shock tower.



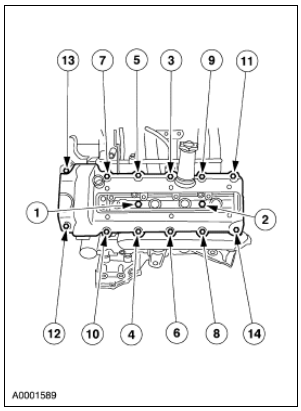
17. Loosen the bolts and position the power steering pump reservoir aside.



18. Remove the nut and the oil level indicator tube.

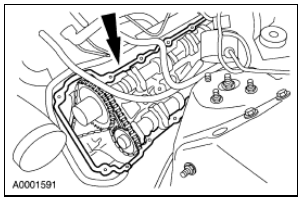


19. Remove the LH valve cover.
    - Loosen the bolts in the sequence shown.

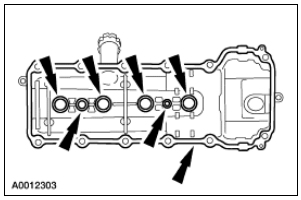


20. ⚠ **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of sealant.**

    Clean the sealing surfaces.



21. Inspect and install new gaskets if necessary.

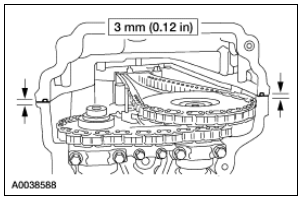


Installation

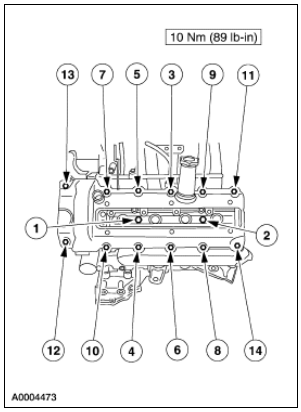
1. **NOTE:** If the valve cover is not secured within four minutes of sealant application the sealant must

be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, which ever is longer. Failure to follow this procedure can cause future oil leakage.

Apply two beads of silicone gasket and sealant as shown.



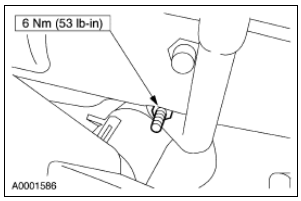
2. Install the LH valve cover.
    - Position the valve cover and tighten the bolts in the sequence shown.



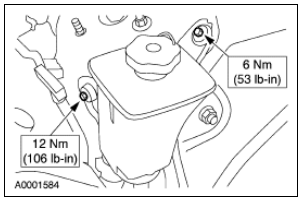
3. **NOTE:** Lubricate the O-ring seal with clean engine oil.

    Install the oil level indicator tube.

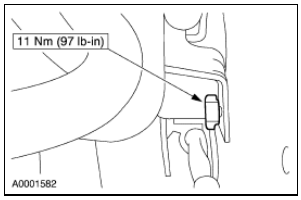
    - Inspect the O-ring seal and install a new O-ring seal if necessary.



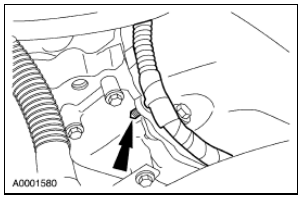
4. Install the power steering pump reservoir.



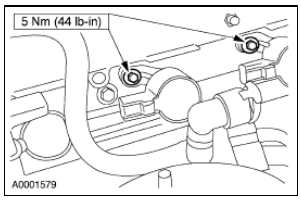
5. Install the fuel hose bracket bolt.



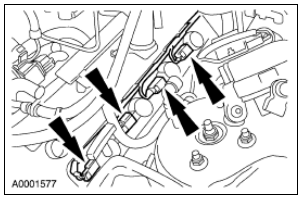
6. Connect the three wiring harness retainers.



7. Install the four LH ignition coils.

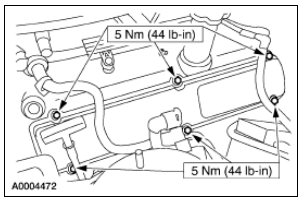


8. Connect the ignition coil electrical connectors.

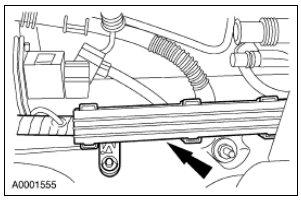


9. ⚠ **CAUTION: Make sure that the wire harness inlet seal is seated on the valve cover or damage to the harness can occur.**

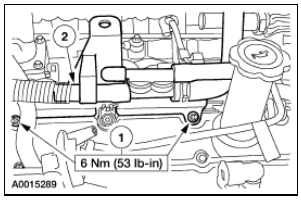
   Install the ignition coil cover.



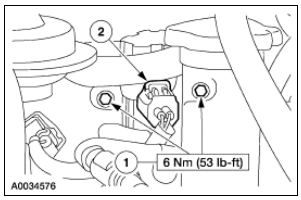
10. Install the engine wiring harness.



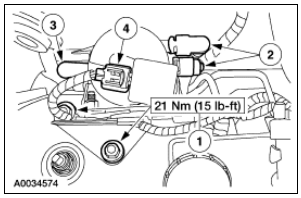
11. Install the bracket.
    1. Install the bracket.
    2. Install the hose.



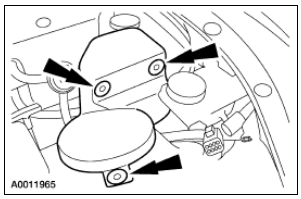
12. Install the EGR vacuum regulator solenoid.
    1. Install the EGR vacuum regulator solenoid and screws.
    2. Connect the electrical connector.



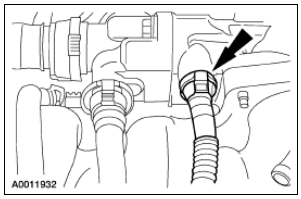
13. Install the VMV.
    1. Install the nuts.
    2. Connect the purge hose.
    3. Connect the vacuum hose.
    4. Connect the electrical connector and wiring harness push pin.



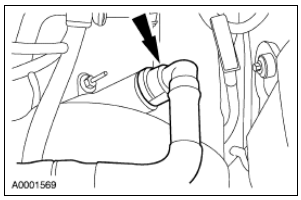
14. Install the VMV cover.



15. Connect the hose.

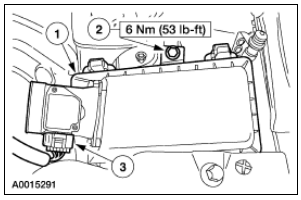


16. Connect the crankcase ventilation tube.



17. Connect the fuel hose. For additional information, refer to Section 310-00 .

18. Install the air cleaner housing.
    1. Install the housing.
    2. Install the bolt.
    3. Connect the MAF sensor electrical connector.



19. Install the air cleaner outlet tube. For additional information, refer to Section 303-12 .

20. Connect the battery ground cable. For additional information, refer to Section 414-01 .

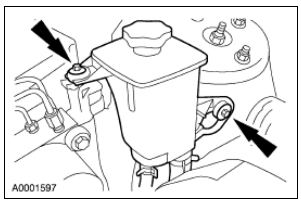
Valve Cover RH

Material

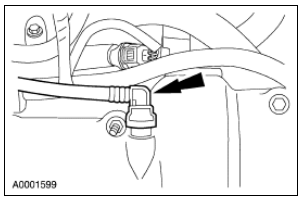
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA (in Canada CXC-111-B) or equivalent	WSE-M4G323-A4
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A

Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
3. Remove the bolts and position the hydraulic cooling fan reservoir aside.

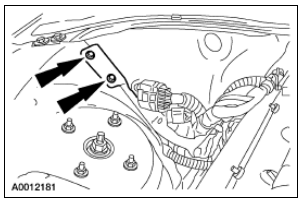


4. Disconnect the crankcase ventilation hose.

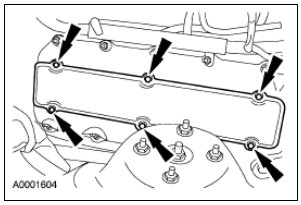


5. **NOTE:** The wiring harness bracket is located on the backside of the RH strut tower.

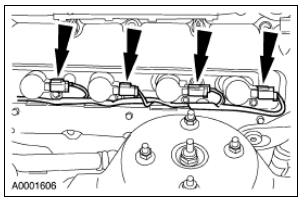
   Remove the bolts and position the wiring harness bracket aside.



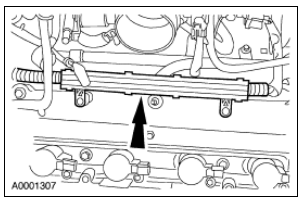
6. Remove the ignition coil cover.
   - Inspect the gasket and install a new gasket as necessary.



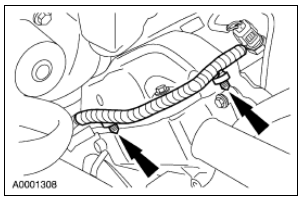
7. Disconnect the ignition coil electrical connectors.



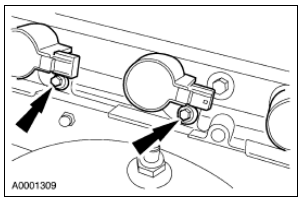
8. Raise the engine wiring harness and disconnect the four fuel injector electrical connectors.



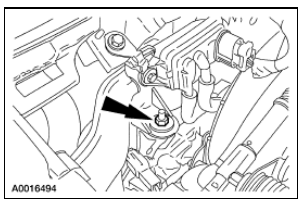
9. Disconnect the three wiring harness retainers.



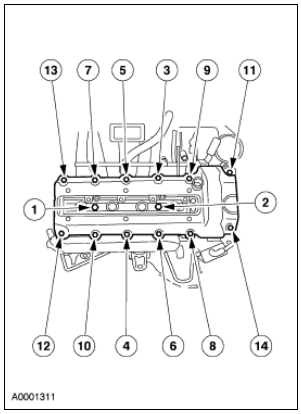
10. Remove the four RH ignition coils.



11. Remove the nut and position the wiring harness aside.

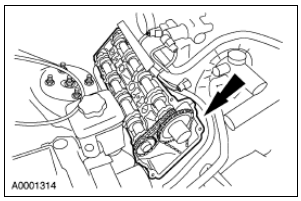


12. Remove the RH valve cover.
    - Loosen the bolts in the sequence shown.

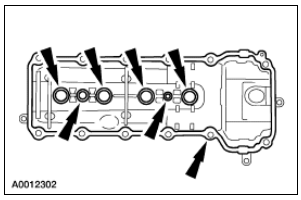


13. ⚠ **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of sealant.**

    Clean the sealing surfaces.



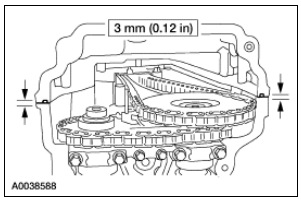
14. Inspect and install new gaskets as necessary.



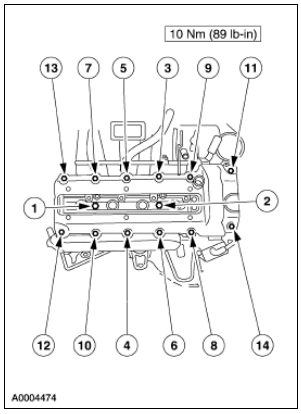
Installation

1. **NOTE:** If the valve cover is not secured within four minutes of sealant application the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, which ever is longer. Failure to follow this procedure can cause future oil leakage.

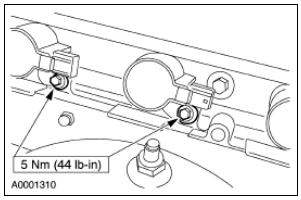
   Apply two beads of silicone gasket and sealant as shown.



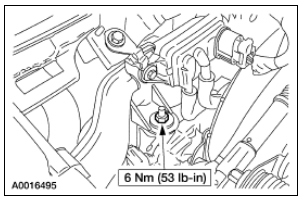
2. Install the RH valve cover.
   - Tighten the bolts in the sequence shown.



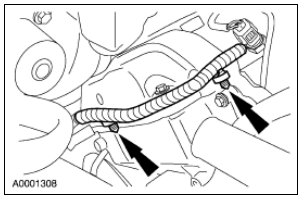
3. Install the ignition coils.



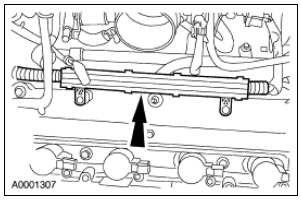
4. Position the wiring harness and install the nut.



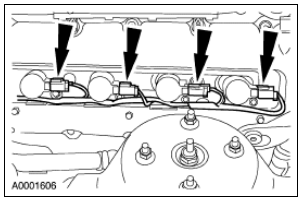
5. Install the three wiring harness retainers.



6. Connect the four fuel injector electrical connectors and position the engine wiring harness.

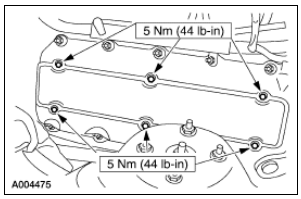


7. Connect the ignition coil electrical connectors.



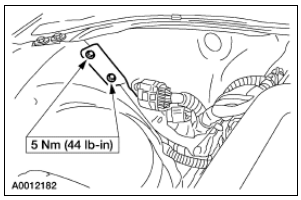
8. ⚠ **CAUTION: Make sure that the wire harness inlet seal is seated in the valve cover or damage to the harness can occur.**

   Inspect the gasket and install a new gasket as necessary. Install the ignition coil cover.

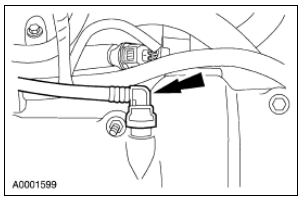


9. **NOTE:** The wiring harness bracket is located on the backside of the RH strut tower.

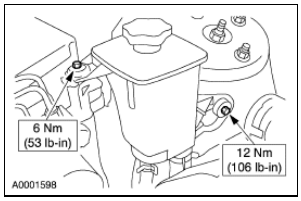
   Install the wiring harness bracket.



10. Connect the crankcase ventilation hose.



11. Install the hydraulic cooling fan reservoir.

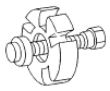
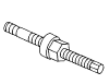


12. Install the air cleaner outlet tube. For additional information, refer to Section 303-12 .

13. Connect the battery ground cable. For additional information, refer to Section 414-01 .

Crankshaft Pulley

Special Tool(s)

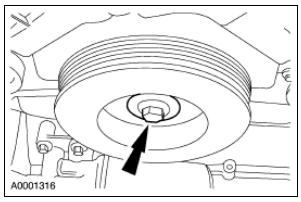
 ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)

Material

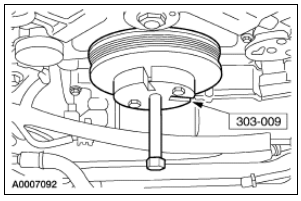
Item	Specification
Silicone Gasket and Sealant F7AZ-19554-EA (in Canada CXC-111-A) or equivalent	WSE-M4G323-A4

Removal

1. Remove the hydraulic cooling fan assembly. For additional information, refer to Section 303-03 .
2. Remove the drive belt. For additional information, refer to Section 303-05 .
3. Remove and discard the bolt.



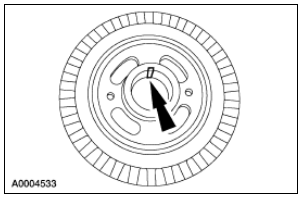
4. Using the special tool, remove the crankshaft pulley.



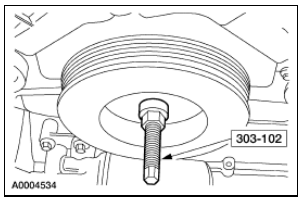
Installation

1. **NOTE:** If crankshaft pulley is not secured within four minutes of sealant application the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

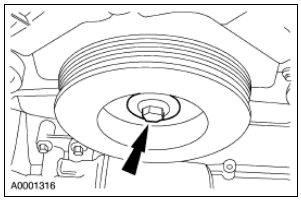
   Apply a bead of silicone gasket and sealant to the keyway.



2. Using the special tool, install the crankshaft pulley.



3. Install a new bolt and tighten in four stages.
    - Stage 1: Tighten to 80 Nm (59 lb-ft).
    - Stage 2: Loosen the bolt two complete turns.
    - Stage 3: Tighten to 50 Nm (37 lb-ft).
    - Stage 4: Tighten an additional 90 degrees.

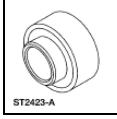


4. Install the drive belt. For additional information, refer to Section 303-05 .

5. Install the hydraulic cooling fan assembly. For additional information, refer to Section 303-03 .

Crankshaft Front Oil Seal

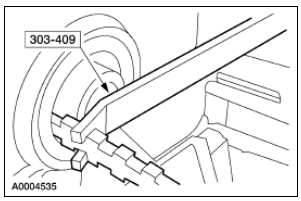
Special Tool(s)

 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)
 ST2423-A	Installer, Crankshaft Front Oil Seal 303-646

Removal

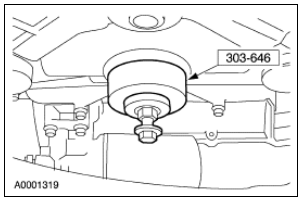
1. Remove the front crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

2. Using the special tool, remove the front crankshaft seal.
   - Discard the seal.



Installation

1. Using the special tool, install a new front crankshaft seal.



2. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

Engine Front Cover

Material

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H
Silicone Gasket and Sealant F7AZ-19554-EA (in Canada CXC-111-B) or equivalent	WSE-M4G323-A4

Removal

1. ⚠ **CAUTION: The cooling system filling and bleeding procedure must be followed exactly or damage to the engine can occur.**

   Drain the engine cooling system. For additional information, refer to Section 303-03 .

2. Drain the engine oil.

3. Remove the LH valve cover. For additional information, refer to Valve Cover LH in this section.

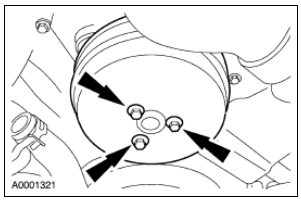
4. Remove the RH valve cover. For additional information, refer to Valve Cover RH in this section.

5. Remove the engine cooling fan assembly. For additional information, refer to Section 303-03 .

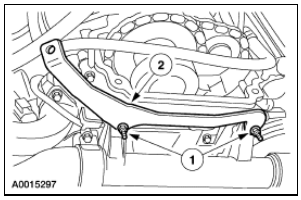
6. Loosen the water pump pulley bolts.

7. Remove the generator. For additional information, refer to Section 414-02 .

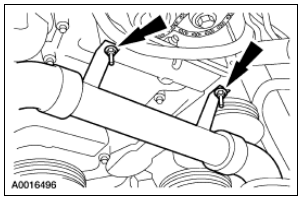
8. Remove the water pump pulley.
   - Discard the bolts.



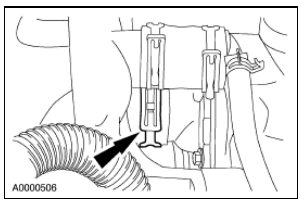
9. Remove the bracket.
   1. Remove the nuts.
   2. Remove the bracket.



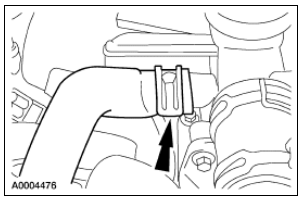
10. Remove the lower radiator hose stud bolts.



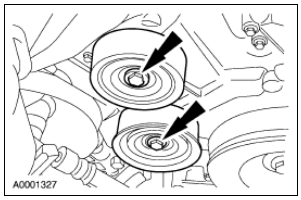
11. Disconnect the lower radiator hose from the thermostat housing.



12. Disconnect the heater hose.



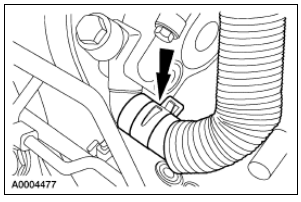
13. Remove the idler pulleys.



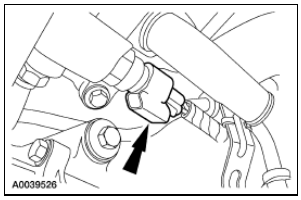
14. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

15. Remove the A/C compressor. For additional information, refer to Section 412-03 .

16. Disconnect the power steering reservoir hose and drain the reservoir

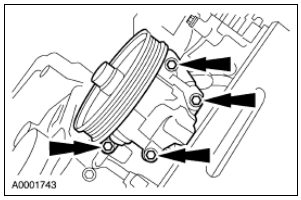


17. Disconnect the power steering pressure (PSP) switch.

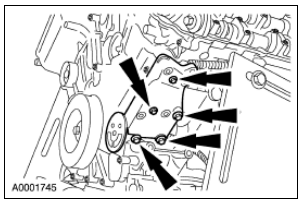


18. **NOTE:** One bolt is blocked by the power steering pressure hose and will have to be removed in stages.

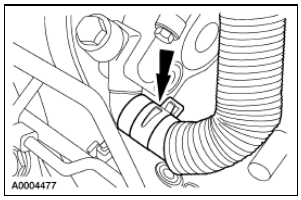
    Remove the bolts and position the power steering pump aside.



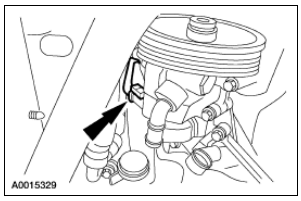
19. Remove the power steering pump bracket.



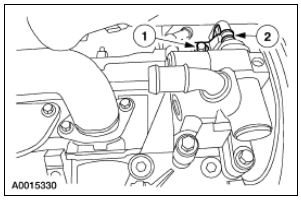
20. Disconnect the hydraulic cooling fan pump reservoir hose and drain the reservoir.



21. Disconnect the electrical connector.

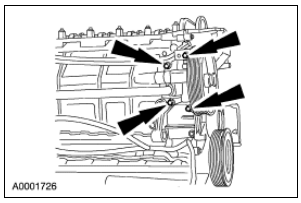


22. Remove the hydraulic fan pump high pressure hose bracket.
    1. Remove the bolt.
    2. Remove the bracket.

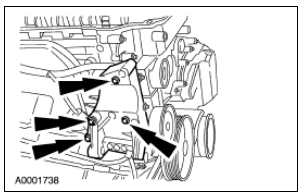


23. **NOTE:** One bolt is blocked by the hydraulic cooling fan pressure hose and must be removed in stages.

    Remove the hydraulic cooling fan pump.

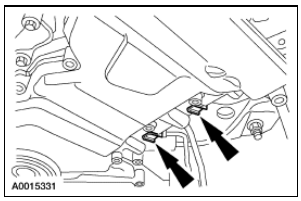


24. Remove the hydraulic cooling fan pump bracket.

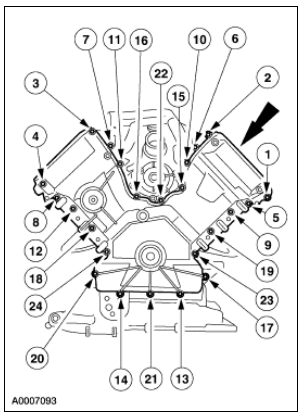


25. Lower the vehicle.

26. Disconnect the five wiring harness clips.

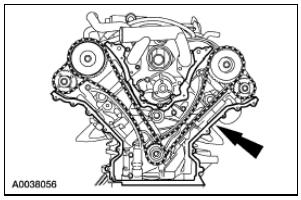


27. Remove the engine front cover.
    - Remove the bolts in the sequence shown.
    - Remove the engine front cover.



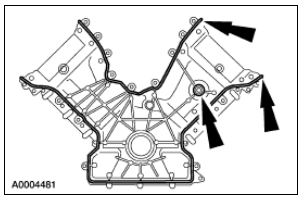
28. ⚠ **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of sealant.**

    Clean the sealing surfaces.



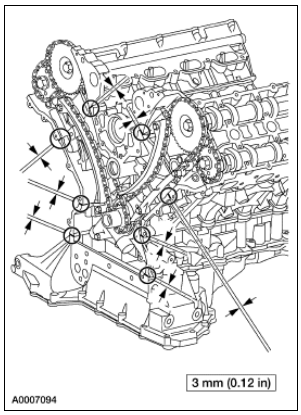
Installation

1. Install new gaskets.

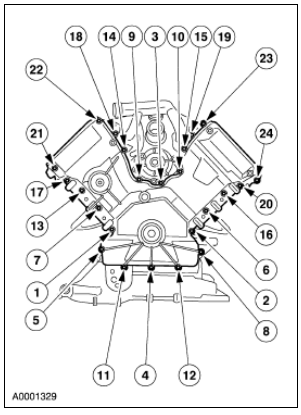


2. **NOTE:** If the front cover is not secured within four minutes of sealant application the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, which ever is longer. Failure to follow this procedure can cause future oil leakage.

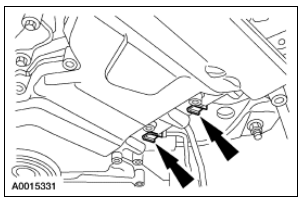
   Apply silicone gasket and sealant in eight places.



3. Install the engine front cover.
   - Position the engine front cover on the cylinder block.
   - Loosely install the bolts.
   - Tighten the bolts in two stages in the sequence shown.
     - Stage 1: Tighten to 5 Nm (44 lb-in).
     - Stage 2: Tighten to 10 Nm (89 lb-in).



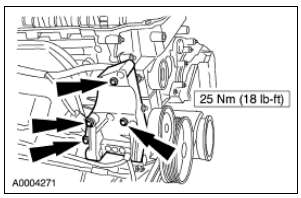
4. Connect the five wiring harness clips.



5. Raise the vehicle.

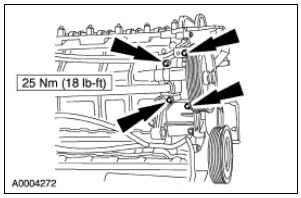
6. **NOTE:** The wiring harness is positioned behind the bracket.

   Install the hydraulic cooling fan pump bracket.

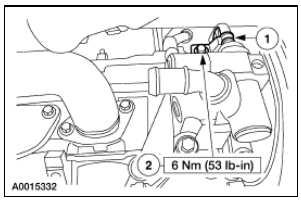


7. **NOTE:** One bolt is blocked by the hydraulic cooling fan pressure hose and will have to be installed in stages.

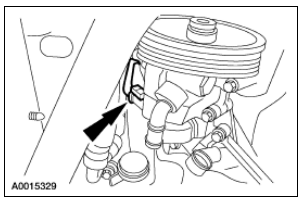
   Install the hydraulic cooling fan pump.



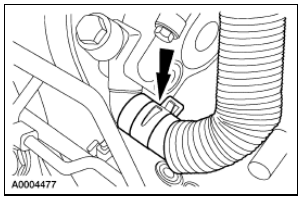
8. Install the hydraulic fan pump high pressure hose bracket.
   1. Install the bracket.
   2. Install the bolt.



9. Connect the electrical connector.

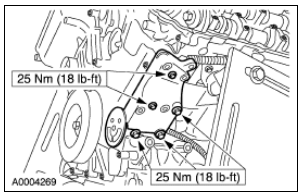


10. Connect the hydraulic cooling fan reservoir hose.



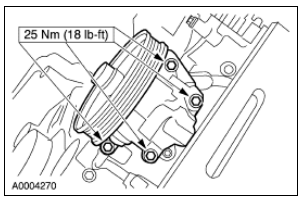
11. **NOTE:** The wiring harness is positioned behind the bracket.

    Install the power steering pump bracket.

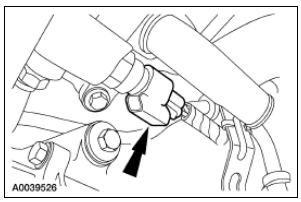


12. **NOTE:** One bolt is blocked by the power steering pressure line and must be installed in stages.

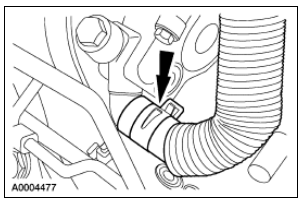
    Install the power steering pump.



13. Connect the power steering pressure (PSP) switch.



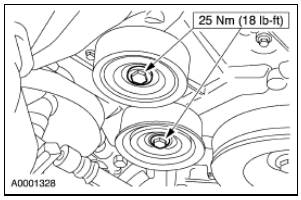
14. Connect the power steering reservoir hose.



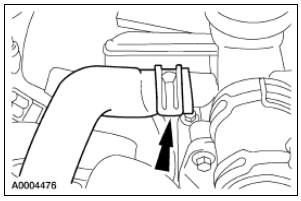
15. Install the A/C compressor. For additional information, refer to Section 412-03 .

16. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

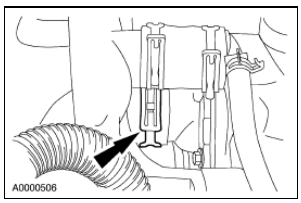
17. Install the idler pulleys.



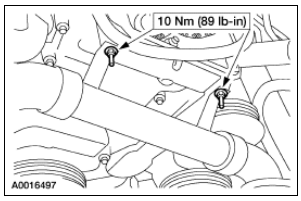
18. Connect the heater hose.



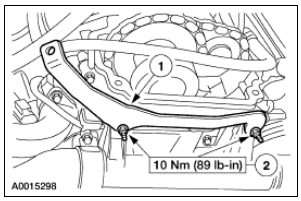
19. Connect the lower radiator hose to the thermostat housing.



20. Install the stud bolts.



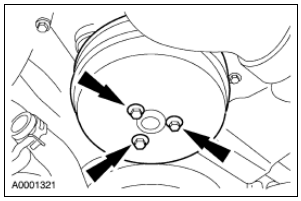
21. Install the bracket.
    1. Install the bracket.
    2. Install the nuts.



22. Position the water pump pulley and loosely install new bolts.

23. Install the generator. For additional information, refer to Section 414-02 .

24. Tighten the bolts in two stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



25. Install the engine cooling fan assembly. For additional information, refer to Section 303-03 .
26. Install the RH valve cover. For additional information, refer to Valve Cover RH in this section.
27. Install the LH valve cover. For additional information, refer to Valve Cover LH in this section.
28. Fill the engine with clean engine oil.
29. **CAUTION: The cooling system filling and bleeding procedure must be followed exactly or damage to the engine can occur.**

    Fill and bleed the engine cooling system. For additional information, refer to Section 303-03 .
30. Fill and bleed the hydraulic cooling fan. For additional information, refer to Section 303-03 .
31. Fill the power steering system. For additional information, refer to Section 211-00 .

Timing Drive Components Primary

Special Tool(s)

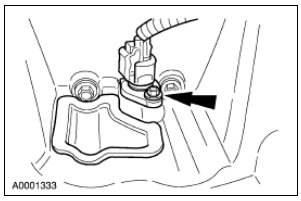
 ST2398-B	Aligner, Camshaft 303-530
 ST2399-A	Tensioner, Timing Chain 303-532
 ST2401-A	Alignment Gauge, Crankshaft 303-645

Removal

1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.

2. Raise the vehicle.

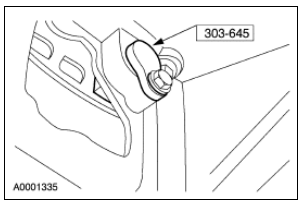
3. Remove the crankshaft position (CKP) sensor and the torque converter cover.


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4. **NOTE:** There is one window on the ignition pulse wheel that is unique to accept the special tool.

   Install the special tool.

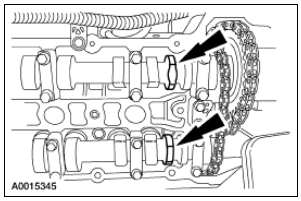
   - Turn the crankshaft to 45 degrees ATDC. The crankshaft keyway will be in the 6 o'clock position.
   - Install the special tool.



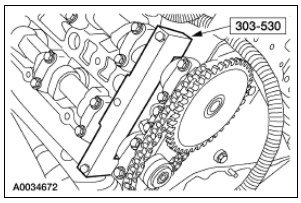
A0001335

5. Lower the vehicle.

6. Make sure the lobes of the camshaft are facing upwards. If not, repeat Step 4.

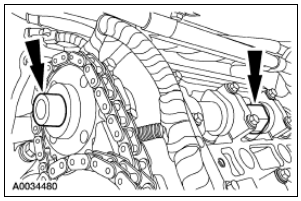


7. Install the special tool on the RH cylinder head.



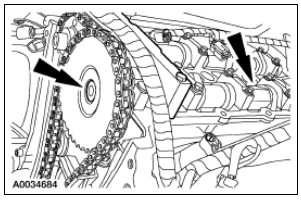
8. ⚠ **CAUTION: An open-end wrench must be used on the flats of the camshaft or damage to the head will occur.**

   Loosen the exhaust camshaft sprocket bolt.

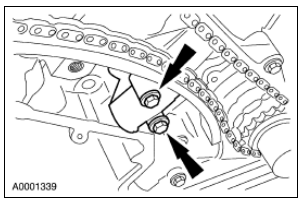


9. ⚠ **CAUTION: An open-end wrench must be used on the flats of the camshaft or damage to the head will occur.**

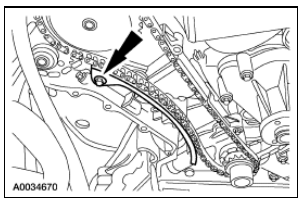
   Loosen the intake camshaft sprocket bolt and slide the camshaft sprockets forward on the bolt.



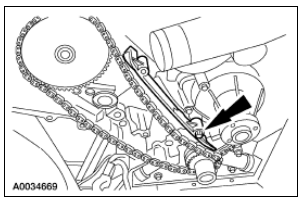
10. Remove the RH timing chain tensioner.



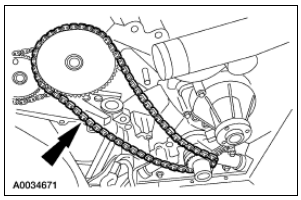
11. Remove the tensioner arm.



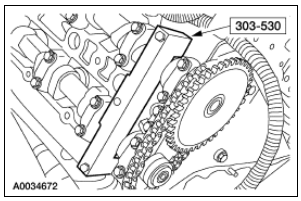
12. Remove the timing chain guide.



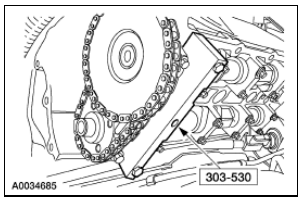
13. Remove the RH primary timing chain.



14. Remove the special tool from the RH head.

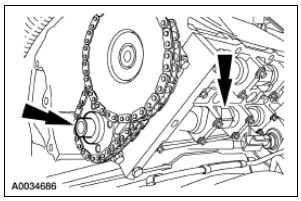


15. Install the special tool on the LH head.



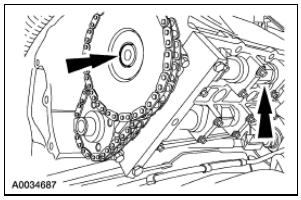
16. ⚠ **CAUTION: An open-end wrench must be used on the flats of the camshaft or damage to the cylinder head will occur.**

    Loosen the exhaust camshaft sprocket bolt.

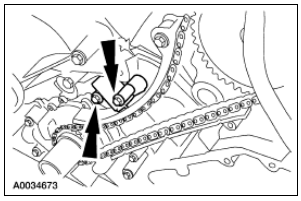


17. ⚠ **CAUTION: An open-end wrench must be used on the flats of the camshaft or damage to the cylinder head will occur.**

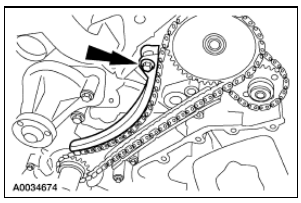
    Loosen the intake sprocket bolt and slide the camshaft sprockets forward on the bolts.



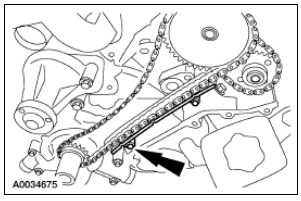
18. Remove the LH timing chain tensioner.



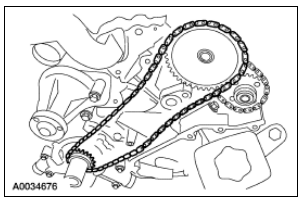
19. Remove the tensioner arm.



20. Remove the timing chain guide.

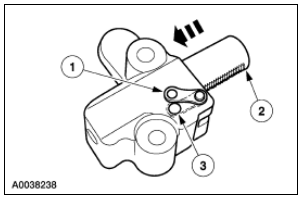


21. Remove the LH primary timing chain and crankshaft sprocket as an assembly.



Installation

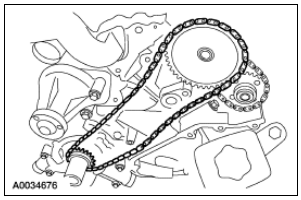
1. Reset the timing chain tensioners.
    1. Hold the lever toward the tensioner piston.
    2. Using finger pressure, compress the tensioner.
    3. Push the lever down and install a drill rod to lock the piston.



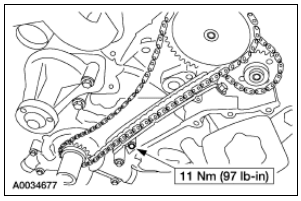
2. **NOTE:** The camshaft holding tool should still be installed on the LH cylinder head.

Position the LH timing chain and crankshaft gear.

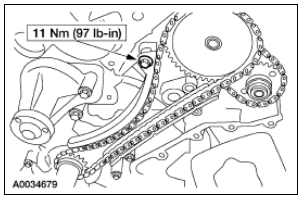
- Position the timing chain over the LH intake camshaft sprocket.
- Position the crankshaft gear in the timing chain.
- Position the timing chain and crankshaft gear over the crankshaft as an assembly.



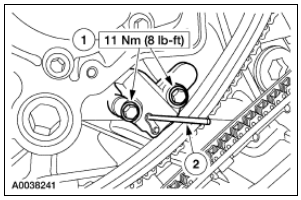
3. Install the LH timing chain guide.



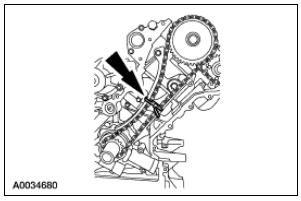
4. Install the LH timing chain tensioner arm.



5. Install the LH timing chain tensioner.
    1. Install the timing chain tensioner and bolts.
    2. Remove the drill rod.



6. Install a tie strap to take up the slack in the timing chain.



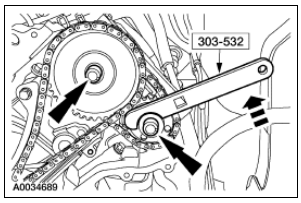
7. **⚠ CAUTION: The exhaust camshaft sprocket bolt must be fully tightened before tightening the intake camshaft sprocket bolt.**

    ⚠ CAUTION: The flats on the camshaft must contact the flats on the special tool.

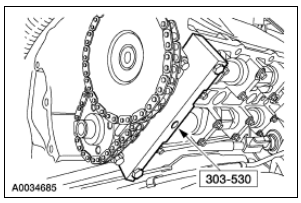
    Using the special tool, apply 10 Nm (89 lb-in) counterclockwise to the LH exhaust camshaft sprocket

and tighten the camshaft bolts in two stages.

- Stage 1 : Tighten to 20 Nm (15 lb-ft).
- Stage 2 : Tighten an additional 90 degrees.

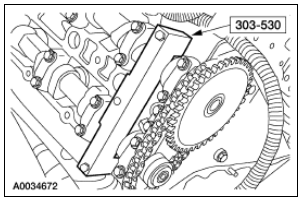


8. Remove the special tool.

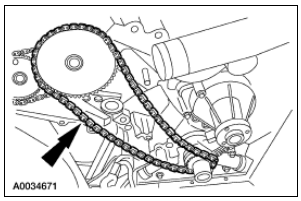


9. Remove the tie strap.

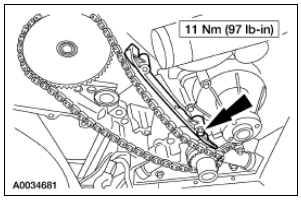
10. Install the special tool on the right cylinder head.



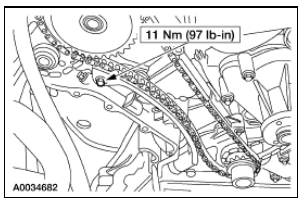
11. Position the RH timing chain over the RH intake camshaft sprocket and over the crankshaft gear.



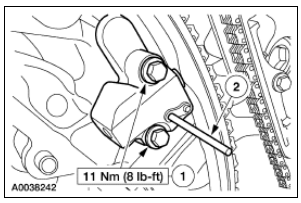
12. Install the RH timing chain guide.



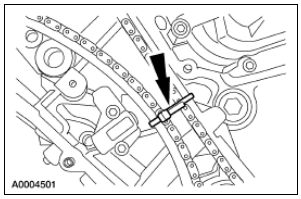
13. Install the RH timing chain tensioner arm.



14. Install the RH timing chain tensioner.
    1. Install the timing chain tensioner and bolts.
    2. Remove the drill rod.



15. Install a tie strap to take up the slack in the timing chain.

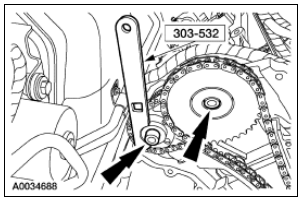


16. ⚠ **CAUTION: The exhaust camshaft sprocket bolt must be fully tightened before tightening the intake camshaft sprocket bolt.**

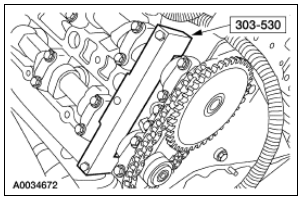
    ⚠ **CAUTION: The flats on the camshaft must contact the flats on the special tool.**

    Using the special tool, apply 10 Nm (89 lb-in) counterclockwise to the RH exhaust camshaft sprocket and tighten the camshaft sprocket bolts in two stages.

    - Stage 1: Tighten to 20 Nm (15 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.

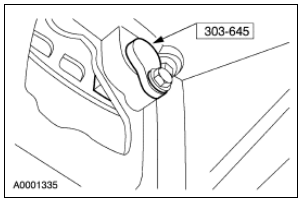


17. Remove the special tool.
    - Remove the tie strap.

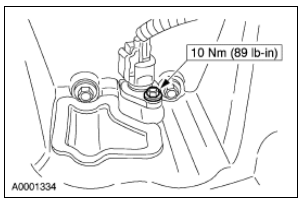


18. Raise the vehicle.

19. Remove the special tool.



20. Install the CKP sensor and the torque converter cover.



21. Lower the vehicle.

22. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

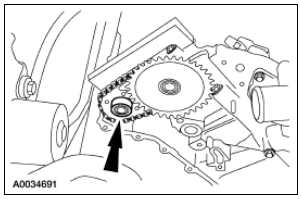
Timing Drive Components Secondary

Removal

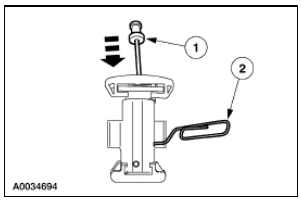
NOTE: The RH secondary timing chains are shown; the LH secondary timing chains are similar.

1. Remove the primary timing chains. For additional information, refer to Timing Drive Components Primary in this section.

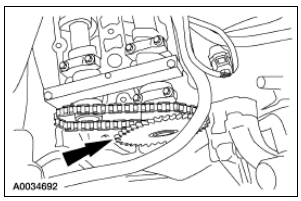
2. Remove the exhaust sprocket bolt.



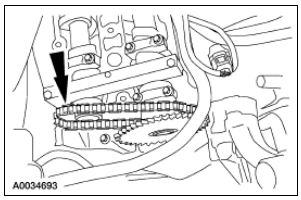
3. Collapse the tensioners.
    1. Insert a thin wire into the check valve and apply hand pressure until the tensioners are fully collapsed.
    2. Install a wire in the side of the tensioner to retain it.



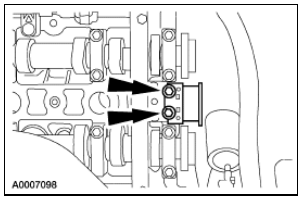
4. Remove the intake sprocket bolt.



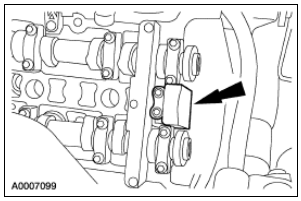
5. Remove the sprockets and chain as an assembly.



6. Remove the secondary timing chain tensioner bolts.

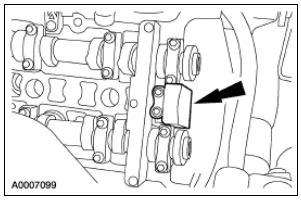


7. Remove the tensioner.

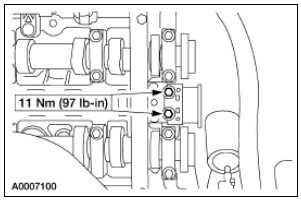


Installation

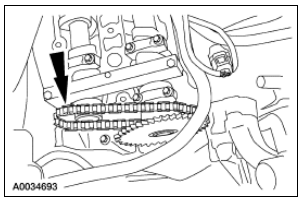
1. Position the tensioner.



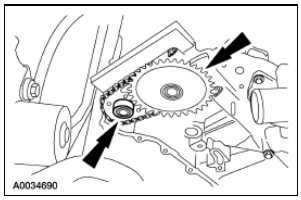
2. Install the timing chain tensioner bolts.



3. Position the intake sprocket, chain and exhaust sprocket on the camshafts as an assembly.

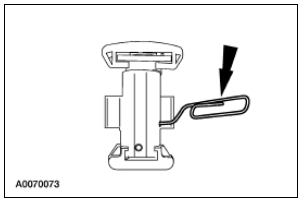


4. Loosely install the intake and exhaust sprocket bolts.



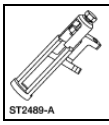
5. Install the primary timing chains. For additional information, refer to Timing Drive Components Primary in this section.

6. Remove the wire retainer from the secondary chain tensioner.


A0070073

Valve Springs

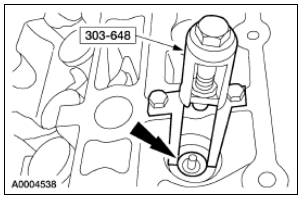
Special Tool(s)

 ST2489-A	Compressor, Valve Spring 303-648

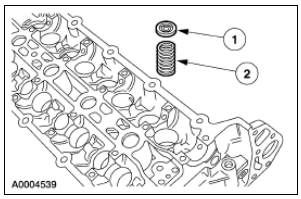
Removal

1. Remove the camshaft. For additional information, refer to Camshaft in this section.
2. Position the piston at the top of the stroke on the appropriate cylinder.
3. Remove the spark plug and apply compressed air in the cylinder to hold both valves in position.
4. ⚠ **CAUTION: If air pressure has forced the piston to the bottom of the cylinder, any loss of air pressure will allow the valve to fall into the cylinder. If air pressure must be removed, support the valve prior to removal.**

   Remove the bucket tappet and shim from the valve.
5. Using the special tool, remove the retainer keys.



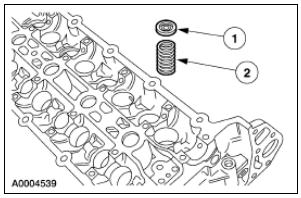
6. Remove the valve springs.
   1. Remove the spring retainers.
   2. Remove the valve springs.



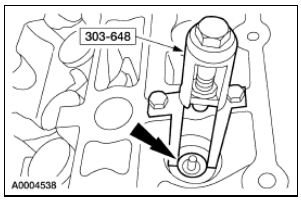
7. Repeat the procedure until all of the valve springs are removed.

Installation

1. Position the valve springs.
   1. Position the spring retainers.
   2. Position the valve springs.



2. Using the special tool, install the retainer keys.



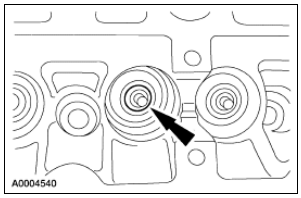
3. Repeat the procedure until all of the valve springs are installed.

4. Install the camshaft. For additional information, refer to Camshaft in this section.

Valve Seals

Removal

1. Remove the valve springs. For additional information, refer to Valve Springs in this section.
2. Remove the valve stem seals.



Installation

1. **NOTE:** The valve stem seal must be bottomed on the valve seat.

   NOTE: Make sure that the garter spring is present in the valve stem seal.

   Install the valve stem seals over the valve stems.
2. Install the valve springs. For additional information, refer to Valve Springs in this section.

Camshaft

Special Tool(s)

 ST2398-B	Aligner, Camshaft 303-530

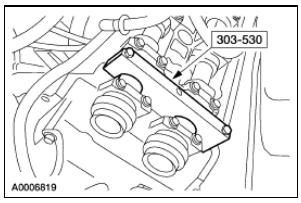
Material

Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

1. Remove the secondary timing chains. For additional information, refer to Timing Drive Components Secondary in this section.

2. Remove the special tool.



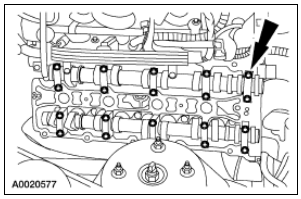
3. **⚠ CAUTION: Record the camshaft bearing cap locations. The camshaft bearing caps are positional and must be installed in their original locations and orientations or engine damage may occur.**

   ⚠ CAUTION: Do not use any means of marking the shims other than a permanent type marker. Any scratches or paint on the shims may result in incorrect lash adjustments and severe engine damage.

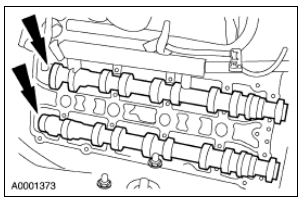
   ⚠ CAUTION: Record the shim and bucket tappet location. The shim and bucket tappet are positional and if installed in the incorrect location, engine damage may occur.

   Remove the RH camshaft bearing caps.

   - Remove the bolts.
   - Remove the RH camshaft bearing caps.



4. Remove the RH camshafts (6A270 intake and 6A272 exhaust).



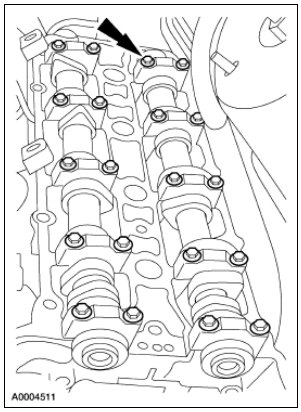
5. **⚠ CAUTION: Record the camshaft bearing cap locations. The camshaft bearing caps are positional and must be installed in their original locations and orientations or engine damage may occur.**

   ⚠ CAUTION: Do not use any means of marking the shims other than a permanent type marker. Any scratches or paint on the shims may result in incorrect lash adjustments and severe engine damage.

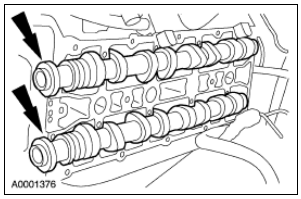
   ⚠ CAUTION: Record the location of the shims and bucket tappets. The bucket tappets and shims are positional and if installed in the incorrect location, engine damage may occur.

   Remove the LH camshaft bearing caps.

   - Remove the bolts.
   - Remove the LH camshaft bearing caps.



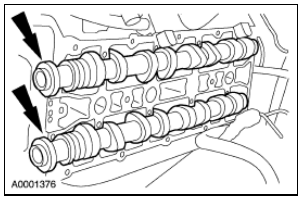
6. Remove the LH camshafts.



Installation

1. **NOTE:** Apply clean engine oil to the camshaft journals, the camshaft caps and the camshaft lobes prior to installing the camshafts.

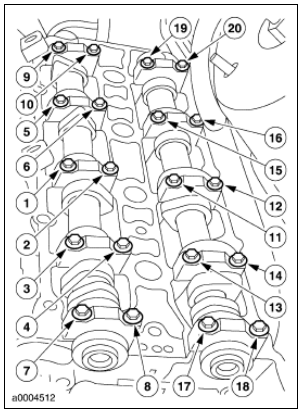
   Position the LH camshafts on the camshaft journals.



2. ⚠ **CAUTION: Install the camshaft bearing caps. The camshaft bearing caps are positional and must be installed in their original locations and orientations or engine damage may occur.**

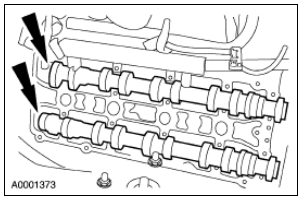
   Install the LH camshaft bearing caps.

   - Position the bearing caps.
   - Install the bearing cap bolts. Tighten the bolts in three stages in the sequence shown.
     - ♦ Stage 1: Hand-tighten.
     - ♦ Stage 2: Tighten to 6 Nm (53 lb-in).
     - ♦ Stage 3: Tighten an additional 90 degrees.



3. **NOTE:** Apply clean engine oil to the camshaft journals, the camshaft caps and the camshaft lobes prior to installing the camshafts.

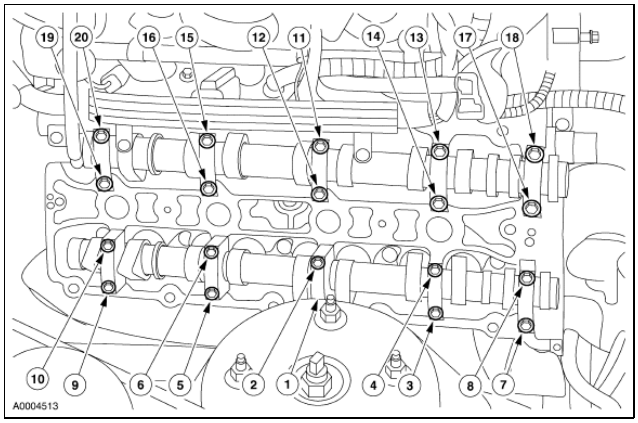
   Install the RH camshafts.



4. ⚠ **CAUTION: Install the camshaft bearing caps. The camshaft bearing caps are positional and must be installed in their original locations and orientations or engine damage may occur.**

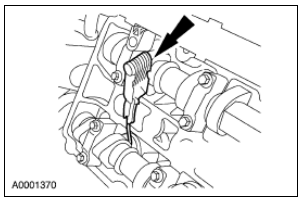
   Install the RH camshaft bearing caps.

   - Position the bearing caps.
   - Install the bolts. Tighten the bolts in three stages in the sequence shown.
     - ♦ Stage 1: Hand-tighten.
     - ♦ Stage 2: Tighten to 6 Nm (53 lb-in).
     - ♦ Stage 3: Tighten an additional 90 degrees.

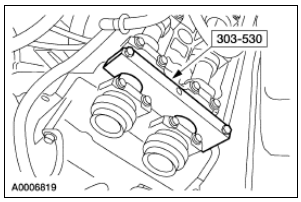


5. ⚠ **CAUTION: If any of the following components are replaced, the engine must be reshimmed or engine damage may occur: The camshafts, the valves, cylinder heads, or bucket tappets .**

   Using feeler gauges, confirm that the tappet and shim clearances are within specification.



6. Install the special tool on the LH head.

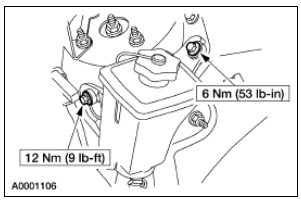


7. Install the secondary timing chains. For additional information, refer to Timing Drive Components Secondary in this section.

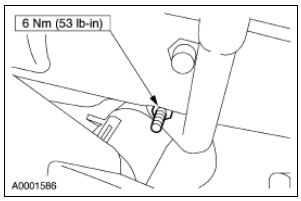
Exhaust Manifold LH

Removal

1. Remove the bolts and position the power steering reservoir aside.



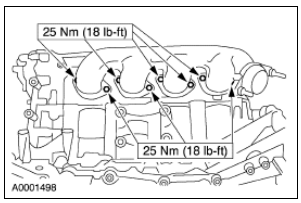
2. Remove the nut and position the oil level indicator tube aside.



3. Raise and support the vehicle. For additional information, refer to Section 100-02 .

4. Disconnect the three-way catalytic (TWC) converter from the exhaust manifold. For additional information, refer to Section 309-00 .

5. Remove the exhaust manifold.
   - Remove the eight bolts.
   - Remove the exhaust manifold and discard the gasket.



Installation

1. To install, reverse the removal procedure.
   - Install a new gasket.

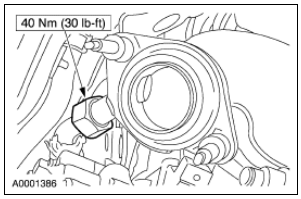
Exhaust Manifold RH

Removal

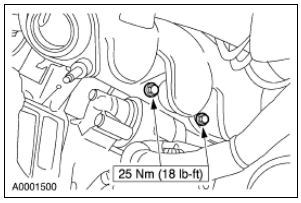
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Disconnect the three-way catalytic (TWC) converter from the exhaust manifold. For additional information, refer to Section 309-00 .

3. Disconnect the EGR valve to exhaust manifold tube nut at the exhaust manifold.



4. Remove the exhaust manifold.
   - Remove the eight bolts.
   - Remove the exhaust manifold and discard the gasket.



Installation

1. To install, reverse the removal procedure.
   - Install a new gasket.

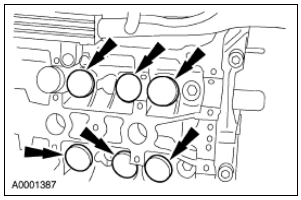
Cylinder Head

Removal

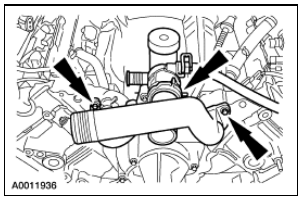
1. Remove the intake manifold. For additional information, refer to Intake Manifold in this section.
2. Remove the engine sound insulator.
3. Remove the camshafts. For additional information, refer to Camshaft in this section.
4. **⚠ CAUTION: The shim and tappets are location-specific. Note the location so that they can be installed in their original locations or shims will have to be reselected during installation.**

   ⚠ CAUTION: Do not use any means of marking the shims other than a permanent type marker. Any scratches or paint on the shims can result in incorrect lash adjustments and severe engine damage.

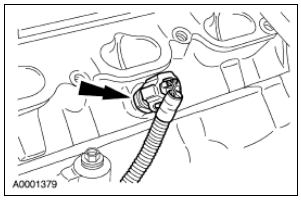
   If necessary, remove the tappet bucket and shims.



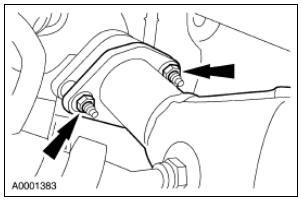
5. Disconnect the clamp, remove the four bolts and the water outlet pipe.



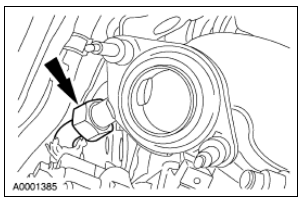
6. Disconnect the cylinder head temperature (CHT) sensor electrical connector.



7. Raise and support the vehicle. For additional information, refer to Section 100-02 .
8. Disconnect the three-way catalytic (TWC) converter from the exhaust manifolds.

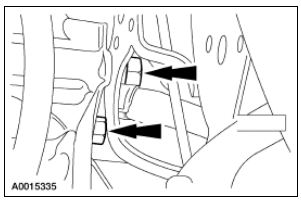


9. Disconnect the EGR valve to exhaust manifold tube.

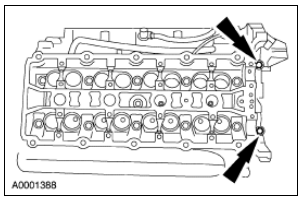


10. Lower the vehicle.

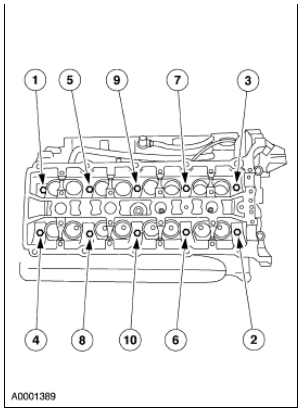
11. Remove the bolts from the rear of the cylinder head.



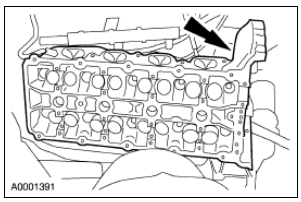
12. Remove and discard the bolts.



13. Remove the RH bolts in the sequence shown.
    - Discard the bolts.



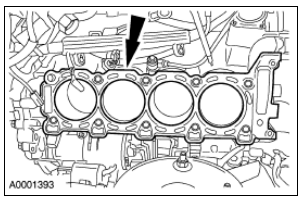
14. Remove the RH cylinder head.
    - Discard the gasket.



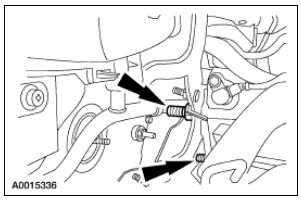
15. ⚠ **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak**

paths. Use a plastic scraping tool to remove all traces of sealant.

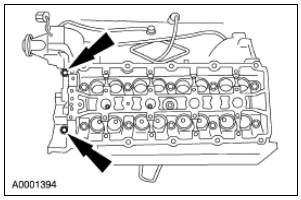
Clean the sealing surfaces.



16. Remove the stud bolts from the rear of the cylinder head.



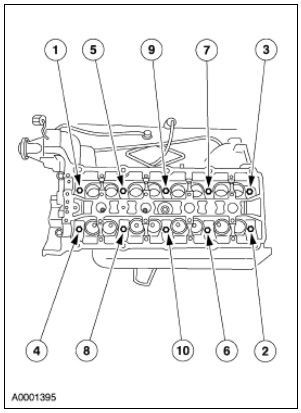
17. Remove and discard the bolts.



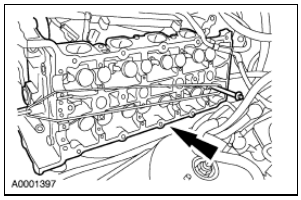
18. **NOTE:** The lower rear bolt cannot be fully removed. This bolt must be retained above the decking surface with a rubber band to remove the LH cylinder head.

    Remove the bolts in the sequence shown.

    - Discard the bolts.

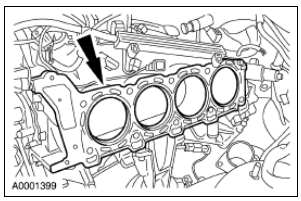


19. Remove the LH cylinder head.
    - Discard the gasket.

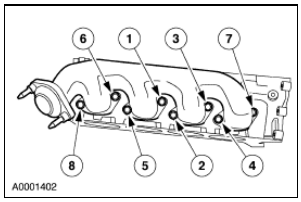


20. ⚠ **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of sealant.**

    Clean the sealing surfaces.

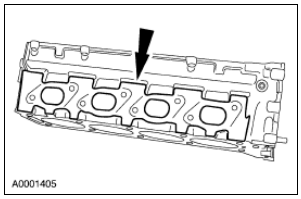


21. Remove the RH exhaust manifold bolts.
    - Discard the gasket.

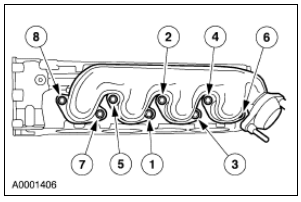


22. ⚠ **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of sealant.**

    Clean the sealing surfaces.

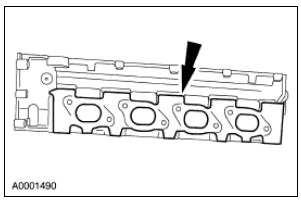


23. Remove the LH exhaust manifold.
    - Discard the gasket.



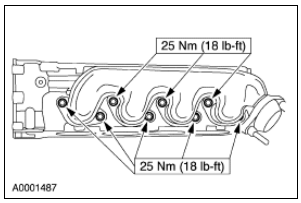
24. ⚠ **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of sealant.**

Clean the sealing surfaces.

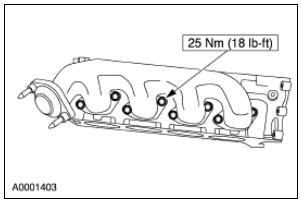


Installation

1. Install the LH exhaust manifold.
   - Install a new gasket.



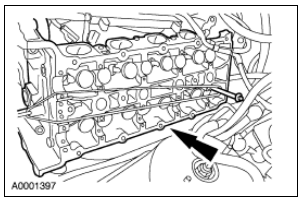
2. Install the RH exhaust manifold.
   - Install a new gasket.



3. **NOTE:** The lower rear bolt cannot be installed with the cylinder head in place. Secure the bolt above deck height with a rubber band prior to cylinder head installation.

   Position the LH cylinder head.

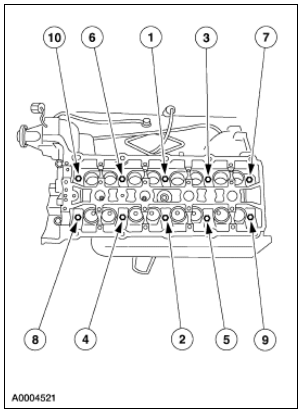
   - Install a new gasket.



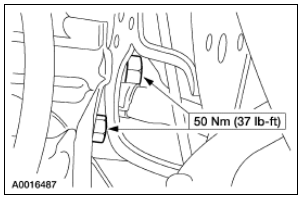
4. **NOTE:** The cylinder head bolts are a torque-to-yield design and must not be reused. Always install new bolts.

   Install and tighten the bolts in five stages in the sequence shown.

   - Stage 1: Install finger-tight.
   - Stage 2: Tighten to 20 Nm (15 lb-ft).
   - Stage 3: Tighten to 35 Nm (26 lb-ft).
   - Stage 4: Tighten to 45 Nm (33 lb-ft) and an additional 90 degrees.
   - Stage 5: Tighten an additional 90 degrees.



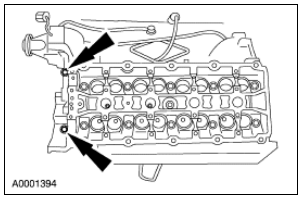
5. Install the bolts on the rear of the cylinder head.



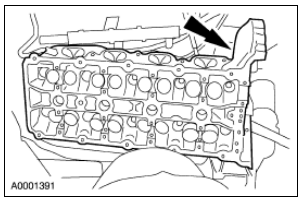
6. **NOTE:** The cylinder head bolts are a torque-to-yield design and must not be reused. Always install new bolts.

   Install and tighten the bolts in two stages.

   - Stage 1: Tighten to 20 Nm (15 lb-ft).
   - Stage 2: Tighten an additional 90 degrees.



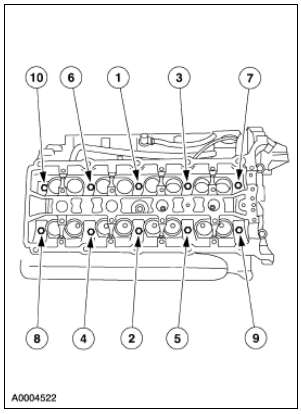
7. Position the RH cylinder head.
   - Install a new gasket.



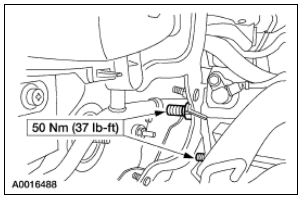
8. **NOTE:** The cylinder head bolts are a torque-to-yield design and must not be reused. Always install new bolts.

   Install and tighten the bolts in five stages in the sequence shown.

   - Stage 1: Install finger-tight.
   - Stage 2: Tighten to 20 Nm (15 lb-ft).
   - Stage 3: Tighten to 35 Nm (26 lb-ft).
   - Stage 4: Tighten to 45 Nm (33 lb-ft) and an additional 90 degrees.
   - Stage 5: Tighten an additional 90 degrees.



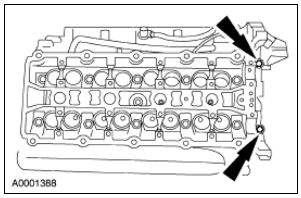
9. Install the stud bolts on the rear of the cylinder head.



10. **NOTE:** The cylinder head bolts are a torque-to-yield design and must not be reused. Always install new bolts.

    Install and tighten the bolts in two stages.

    - Stage 1: Tighten to 20 Nm (15 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.

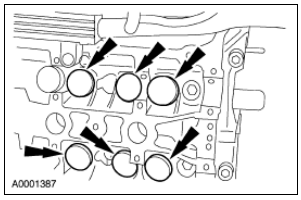


11. **⚠ CAUTION: The shim and tappets are location-specific. They must be installed in their original locations or shims will have to be reselected during installation.**

    ⚠ CAUTION: Do not use any means of marking the shims other than a permanent type marker. Any scratches or paint on the shims can result in incorrect lash adjustments and severe engine damage.

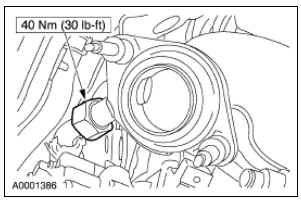
    ⚠ CAUTION: If a new cylinder head assembly is being installed, valve clearances must be adjusted or damage to the engine can occur.

    Install the tappets and shims.

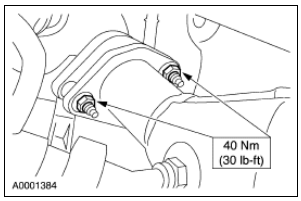


12. Raise the vehicle.

13. Connect the EGR valve to exhaust manifold tube.

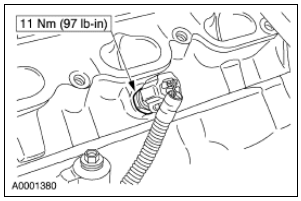


14. Connect the TWC to the exhaust manifolds.



15. Lower the vehicle.

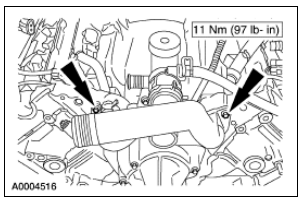
16. Connect the CHT sensor electrical connector.



17. **NOTE:** Make sure that the insulator is clear of the intake manifold sealing surfaces.

    Install the engine sound insulator.

18. Install the water crossover and tighten the four bolts and connect the hose.



19. Install the camshafts. For additional information, refer to Camshaft in this section.

20. Install the intake manifold. For additional information, refer to Intake Manifold in this section.

Oil Cooler

Material

Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

1. ⚠ **CAUTION: The cooling system filling and bleeding procedure must be followed exactly or damage to the engine can occur.**

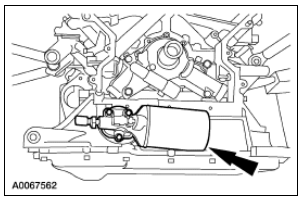
   Drain the cooling system. For additional information, refer to Section 303-03 .

2. Raise and support the vehicle. For additional information, refer to Section 100-02 .

3. Remove the lower splash shield.

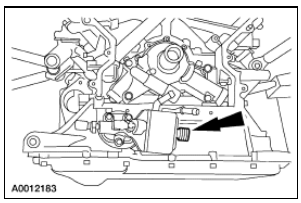
4. Drain the engine oil.

5. Remove and discard the oil filter.



6. Disconnect the oil cooler hoses.

7. Remove the oil cooler.
   - Inspect the seal and install a new seal as necessary.

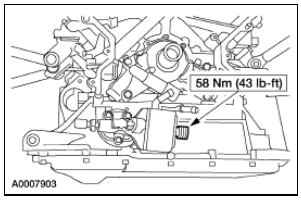


Installation

1. **NOTE:** Inspect the gasket and surfaces for contamination prior to installation.

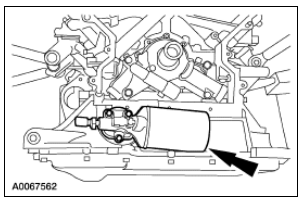
   Position the oil cooler and gasket and install the bolt.

   - Rotate the cooler clockwise until the locating pin hits the stop.



2. Install the oil cooler hoses.

3. Install the oil filter.
   - Install the oil filter until the seal makes contact.
   - Tighten an additional 270 degrees.



4. Install the lower splash shield.

5. Lower the vehicle. For additional information, refer to Section 100-02 .

6. Fill the engine with clean engine oil.

7. ⚠ **CAUTION: The cooling system filling and bleeding procedure must be followed exactly or damage to the engine can occur.**

   Fill and bleed the engine cooling system. For additional information, refer to Section 303-03 .

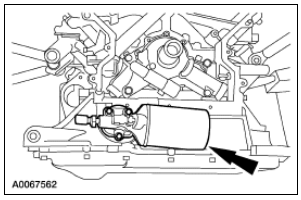
Oil Filter Adapter

Material

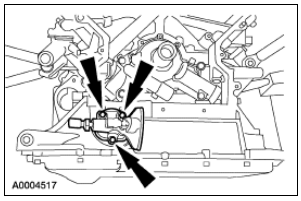
Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Drain the engine oil.
3. Remove the lower splash shield.
4. Remove and discard the oil filter.



5. Remove the oil cooler assembly, if equipped. For additional information, refer to Oil Cooler in this section.
6. Disconnect the oil pressure sender.
7. Remove the oil filter adapter assembly.
   - Discard the seal.

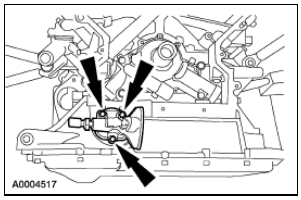


8. ⚠ **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs, or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool.**

   Clean the sealing surfaces.

Installation

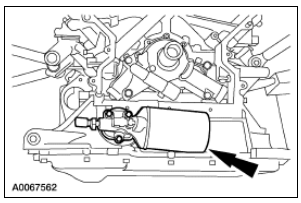
1. Install a new seal and the oil filter adapter. Tighten the bolts in two stages.
   - Stage 1: Tighten to 13 Nm (10 lb-ft).
   - Stage 2: Tighten an additional 90 degrees.



2. Connect the oil pressure sender.

3. Install the oil cooler, if equipped. For additional information, refer to Oil Cooler in this section.

4. Install the oil filter.
   - Install the oil filter until the seal makes contact.
   - Tighten an additional 270 degrees.



5. Install the lower splash shield.

6. Lower the vehicle.

7. Fill the engine with clean engine oil.

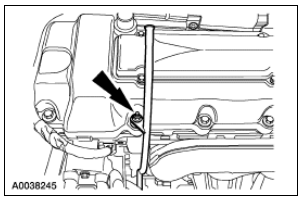
Oil Level Indicator and Tube

Material

Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

1. Remove the oil level indicator.
2. Remove the nut and the oil level indicator and tube.

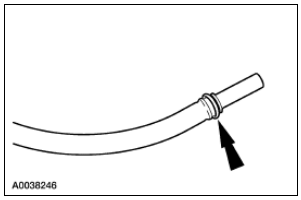


Installation

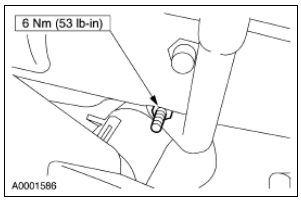
1. **NOTE:** Lubricate the O-ring seal with clean engine oil.

   Inspect the O-ring seal and install a new O-ring seal as necessary.

   - Install the oil level indicator tube.



2. Install the nut.



3. Install the oil level indicator.

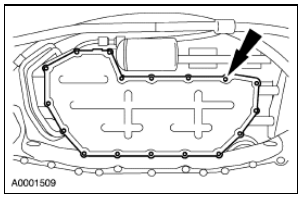
Oil Pan

Material

Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

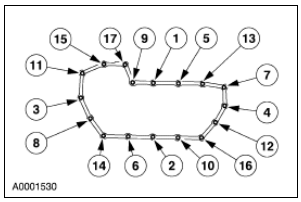
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Drain the engine oil.
3. Remove the oil pan.
   - Inspect the gasket and install a new one if necessary.



Installation

NOTE: Make sure all gasket sealing surfaces are clean and dry.

1. Install the oil pan. Tighten the bolts in the sequence shown in two stages.
   - Stage 1: Tighten to 5 Nm (44 lb-in).
   - Stage 2: Tighten to 12 Nm (9 lb-ft).



2. Lower the vehicle.
3. Fill the crankcase with clean engine oil.

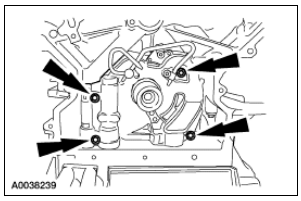
Oil Pump

Removal

1. Remove the primary timing chains. For additional information, refer to Timing Drive Components Primary in this section.

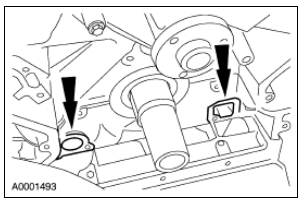
2. Remove the oil pump screen and pickup tube. For additional information, refer to Oil Pump Screen and Pickup Tube in this section.

3. Remove the bolts and the oil pump.
   - Discard the gasket.



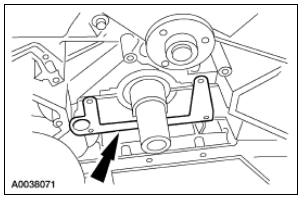
4. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of sealant.**

   Clean the sealing surfaces.

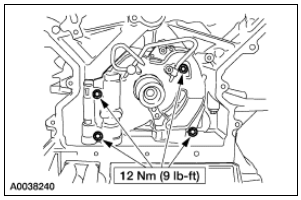


Installation

1. Install a new gasket.



2. Install the oil pump and tighten the bolts in two stages.
   - Stage 1: Tighten to 6 Nm (53 lb-in).
   - Stage 2: Tighten an additional 90 degrees.



3. Install the oil pump screen and pick up tube. For additional information, refer to Oil Pump Screen and Pickup Tube in this section.

4. Install the primary timing chains. For additional information, refer to Timing Drive Components Primary in this section.

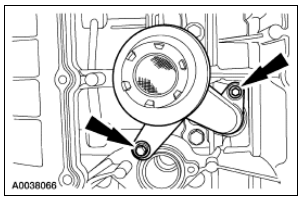
Oil Pump Screen and Pickup Tube

Removal

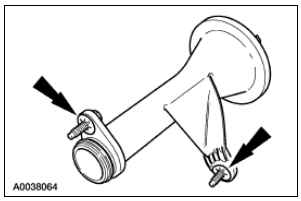
1. Remove the oil pan. For additional information, refer to Oil Pan in this section.
2. ⚠ **CAUTION: Only use hand tools to remove the oil pump screen and pick up tube.**

   Remove the bolts and the pump screen cover and tube.

   - Inspect the O-ring seal and install a new one if necessary.



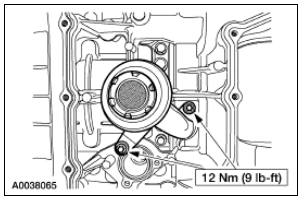
3. Verify the retaining washers are in place.



Installation

1. **NOTE:** Apply clean engine oil to the O-ring prior to installing.

   Install the oil pump screen cover and tube.



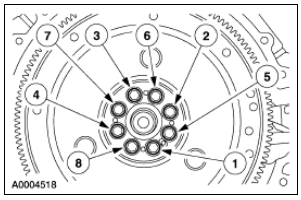
2. Install the oil pan. For additional information, refer to Oil Pan in this section.

Flexplate

Removal

1. Remove the transmission. For additional information, refer to Section 307-01 .

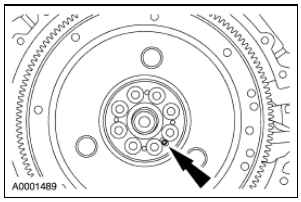
2. Remove the flexplate.
   - Remove the bolts in the sequence shown.
   - Remove the flexplate.



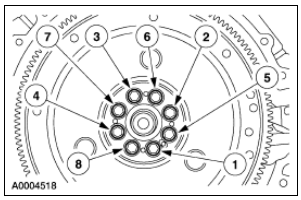
Installation

NOTE: The crankshaft dowel must be positioned below the outer face of the flexplate.

1. Install the flexplate with the elongated hole over the crankshaft dowel.



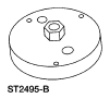
2. Install the flexplate bolts and tighten in two stages in the sequence shown.
   - Stage 1: Tighten to 15 Nm (11 lb-ft).
   - Stage 2: Tighten to 110 Nm (81 lb-ft).



3. Install the transmission. For additional information, refer to Section 307-01 .

Crankshaft Rear Oil Seal

Special Tool(s)

 ST2495-B	Remover/Installer, Crankshaft Rear Oil Seal 303-647
 ST2441-A	Adapter for 204-185 204-208 (T95T-5310-AR2)

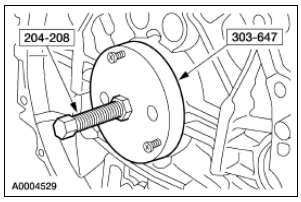
Material

Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

1. Remove the flexplate. For additional information, refer to Flexplate in this section.

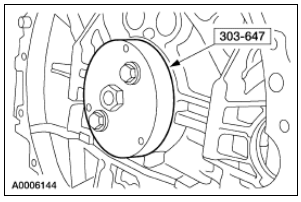
2. Using the special tools, remove the crankshaft rear oil seal.
   - Discard the seal.



Installation

1. Lubricate the outer lips and the inner seal on the crankshaft rear oil seal with clean engine oil.

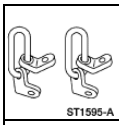
2. Using the special tool, install a new crankshaft rear oil seal.



3. Install the flexplate. For additional information, refer to Flexplate in this section.

Engine Mount

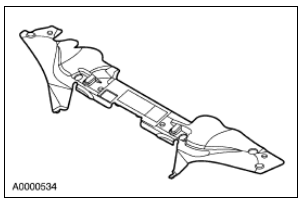
Special Tool(s)

 ST1595-A	Lifting Bracket, Engine 303-050 (T70P-6000)
 ST1703-A	Support Bar, Engine 303-D063 (D88L-6000-A)

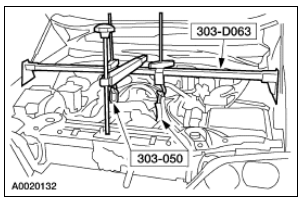
Removal

For LH and RH

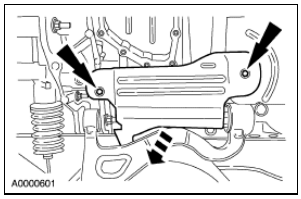
1. Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .
2. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
3. Remove the upper radiator sight shield.



4. Install the special tools and support the engine.

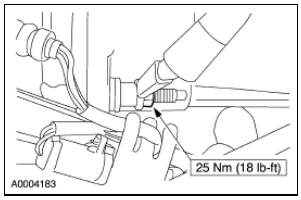


5. Raise and support the vehicle. For additional information, refer to Section 100-02 .
6. Remove the LH and the RH lower splash shield.

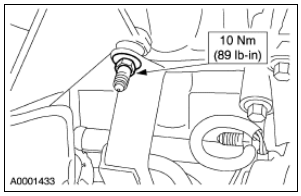


For RH

7. Remove the nut and disconnect the starter motor ground cable.

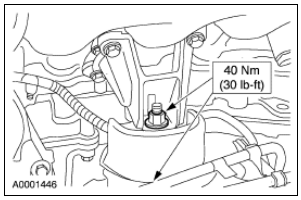


8. Remove the nut and disconnect the wiring harness support bracket from the engine mount bracket.

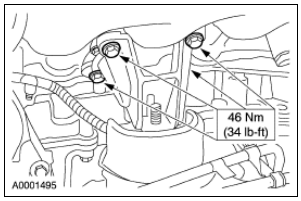


For LH and RH

9. Remove the two nuts from the top and bottom of the engine mounts.



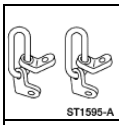
10. Remove the four bolts, the engine mounts and the brackets.



11. To install, reverse the removal procedure.

Engine

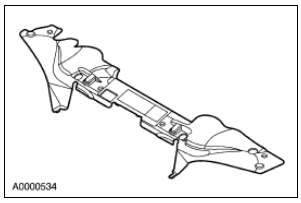
Special Tool(s)

 ST1595-A	Lifting Brackets, Engine 303-050 (T70P-6000)
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3)

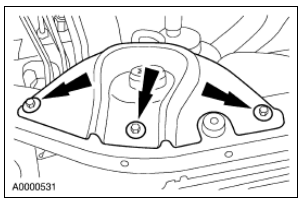
Removal

1. Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .
2. Remove the air cleaner inlet. For additional information, refer to Section 303-12 .
3. ⚠ **CAUTION: The coolant drain procedure must be followed exactly or damage to the engine can occur.**

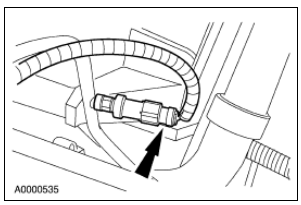
   Drain the engine coolant. For additional information, refer to Section 303-03 .
4. Remove the upper radiator sight shield.



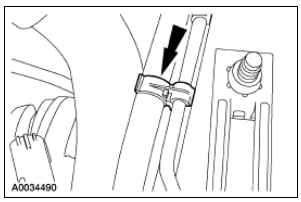
5. Remove the two upper radiator support brackets.



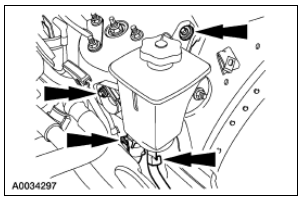
6. Discharge the A/C system. For additional information, refer to Section 412-00 .
7. Disconnect the A/C pressure switch electrical connector.



8. Release the power steering return hose from the pressure hose clip.

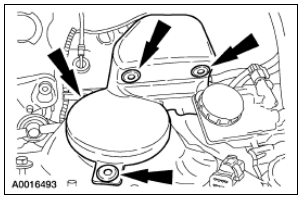


9. Loosen the power steering pump reservoir bolts, disconnect the power steering hoses and remove the power steering reservoir.



10. Disconnect the fuel hose. For additional information, refer to Section 310-00 .

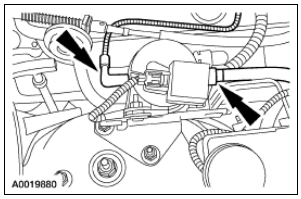
11. Remove the vapor management valve (VMV) cover.



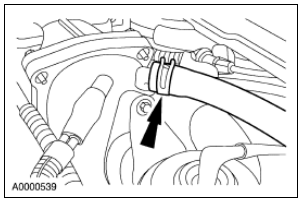
12. ⚠ **CAUTION: To disconnect the Norma fitting, squeeze the tabs and pull straight out or damage to the fitting can occur.**

    Disconnect the VMV.

    - Canister purge hose.
    - Vacuum hose.

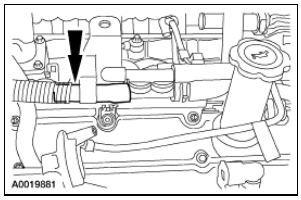


13. Disconnect the main vacuum supply hose.

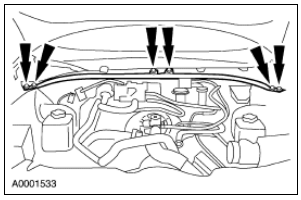


14. Remove the cowl vent screens. For additional information, refer to Section 501-02 .

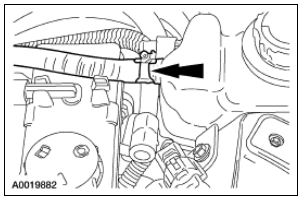
15. Unclip the hose and position aside.



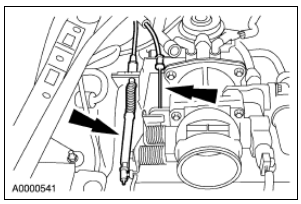
16. Remove the bracket.
    - Remove the seven bolts and one nut.
    - Remove the windshield washer hose.
    - Remove the bracket.



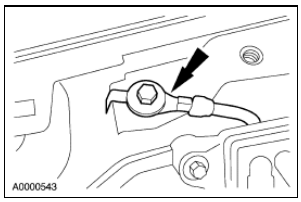
17. Disconnect the degas bottle hose.



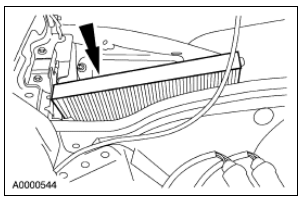
18. Disconnect the accelerator cable and the speed control cable.



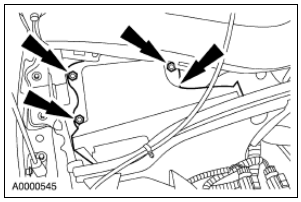
19. Disconnect the ground strap.



20. Remove the fresh air filter.

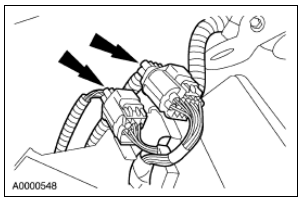


21. Remove the fresh air filter housing.

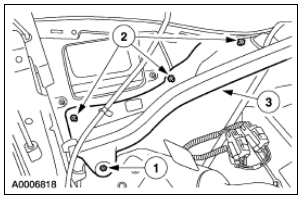


22. **NOTE:** The connectors are located on the backside of the RH strut tower.

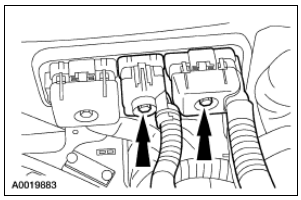
    Disconnect the powertrain bulkhead electrical connectors.



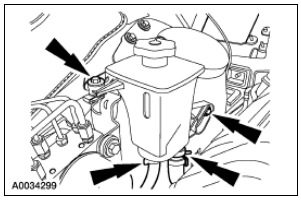
23. Remove the fresh air filter panel.
    1. Remove the pin-type retainer.
    2. Remove the nuts.
    3. Remove the panel.



24. Disconnect the connectors.

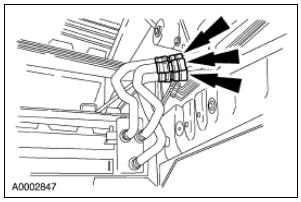


25. Remove the hydraulic cooling fan reservoir bolts, disconnect the cooling fan hoses and remove the reservoir.

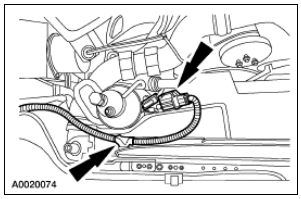


26. **NOTE:** Mark the position of the heater hoses for correct installation.

    Disconnect the heater hoses from the water control valve.



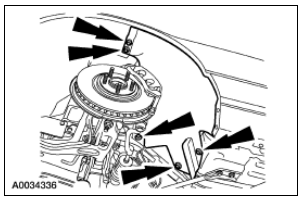
27. Disconnect the water valve electrical connector, unclip from the radiator support and position the harness aside.



28. Remove the front wheels and tires. For additional information, refer to Section 204-04 .

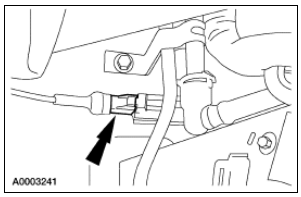
29. **NOTE:** LH shown; RH similar.

    Remove the LH and the RH inner splash shields.



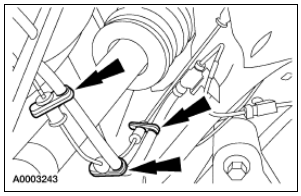
30. **NOTE:** LH shown; RH similar.

    Disconnect the LH and the RH anti-lock brake sensor electrical connectors.



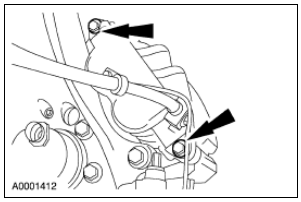
31. **NOTE:** LH shown; RH similar.

    Unclip the LH and the RH anti-lock brake harness from the brake hoses.



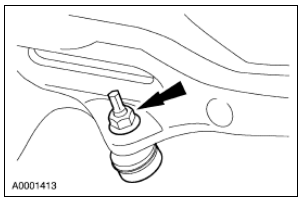
32. **NOTE:** LH shown; RH similar.

    Remove the LH and the RH brake calipers and position the calipers aside.



33. **NOTE:** LH shown; RH similar.

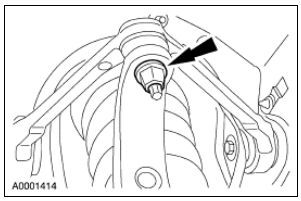
    Remove the LH and the RH stabilizer bar lower nuts.



34. **NOTE:** LH shown; RH similar.

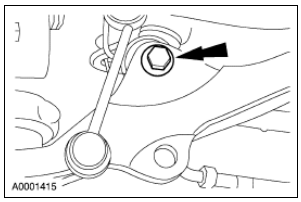
    NOTE: Hold external hex when removing the ball joint nuts to prevent damage to the ball joints.

    Remove the LH and the RH nuts and separate the ball joints from the spindles.



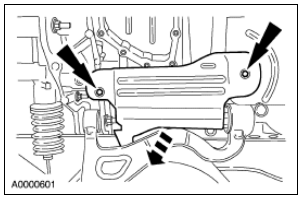
35. **NOTE:** LH shown; RH similar.

    Remove the LH and the RH lower strut mount bolts.

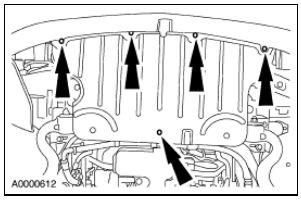


36. **NOTE:** LH shown; RH similar.

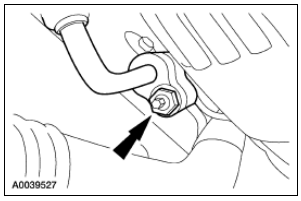
    Remove the LH and the RH splash shields.



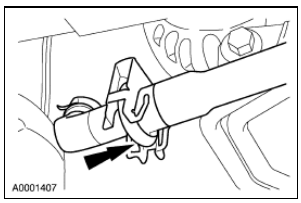
37. Remove the center splash shield.



38. Remove the nut and disconnect the A/C high pressure hose.

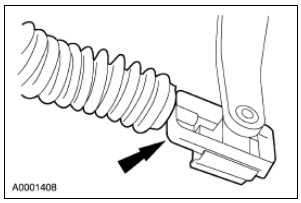


39. Disconnect the low pressure A/C hose.

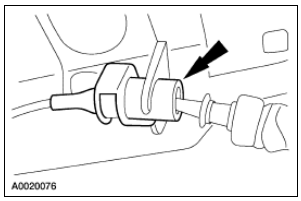


40. Remove the driveshaft. For additional information, refer to Section 205-01 .

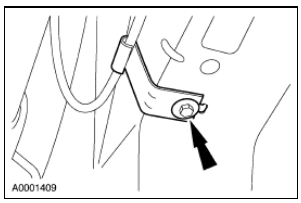
41. Disconnect the shift cable from the shifter.



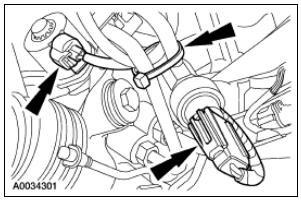
42. Unclip the shift cable from the bracket.



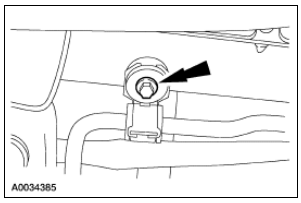
43. Remove the shift cable bracket.



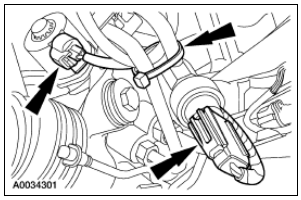
44. Release the hydraulic cooling fan return hose from the RH frame rail.



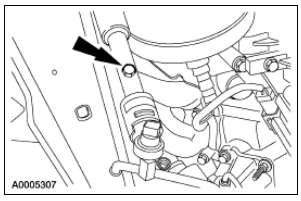
45. Remove the retaining bolt for the high pressure power steering hose bracket.



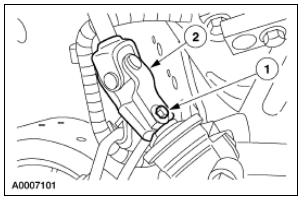
46. Disconnect the rack and pinion steering unit electrical connectors and remove the tie- strap.



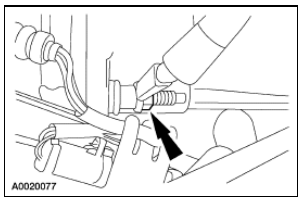
47. Remove the steering shaft bolt.



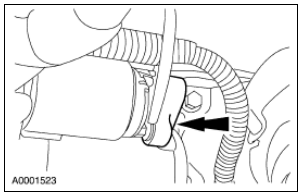
48. Disconnect the steering coupling.
    1. Remove the bolt.
    2. Disconnect the coupling.



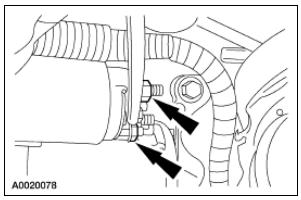
49. Remove the starter motor ground cable.



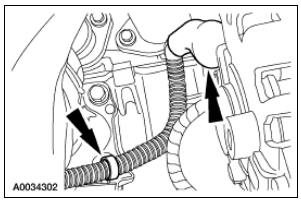
50. Remove the cover.



51. Disconnect the starter motor electrical connectors.

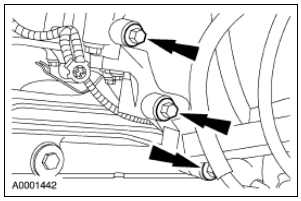


52. Disconnect the generator electrical connector.

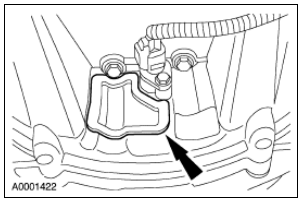


53. Remove the three-way catalytic converter (TWC). For additional information, refer to Section 309-00 .

54. Remove the six lower transmission to engine bolts.

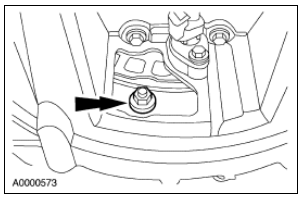


55. Remove the cover.

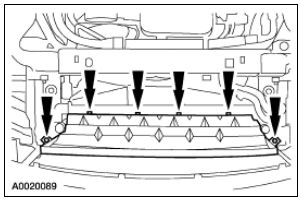


56. **NOTE:** Make an identifying mark on the nut, stud, and adapter plate to allow for correct installation.

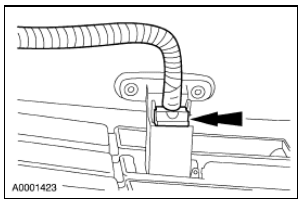
    Remove the eight torque converter nuts.



57. Remove the inner air deflector.

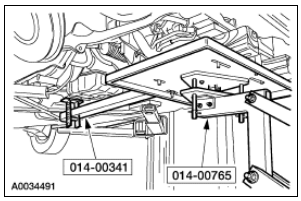


58. Remove the engine block heater plug, if equipped.

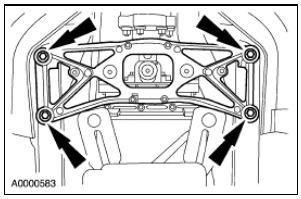


59. Support the rear of the vehicle with suitable safety stands.

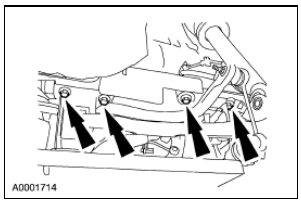
60. Support the engine, transmission, front and center crossmembers, and the cooling system with a powertrain lift and a transmission support bracket.



61. Remove the transmission crossmember bolts.

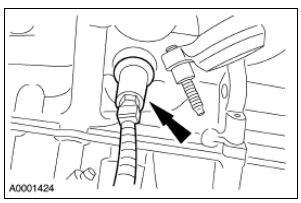


62. Remove the four front and the four center crossmember bolts.

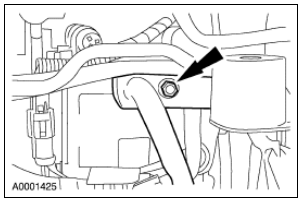


63. Carefully lower the entire assembly from the vehicle.

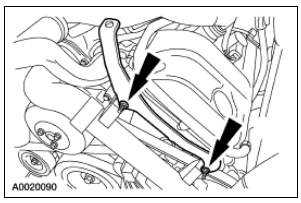
64. Disconnect the block heater, if equipped.



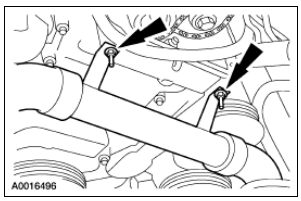
65. Disconnect the A/C manifold and tube.



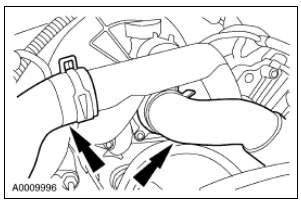
66. Remove the bracket.



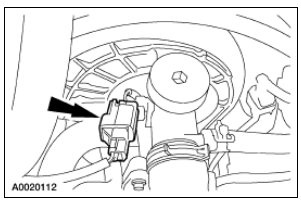
67. Remove the lower radiator hose.



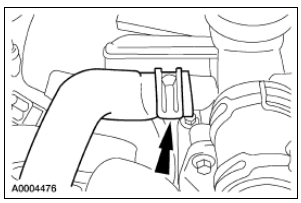
68. Disconnect the radiator hoses.



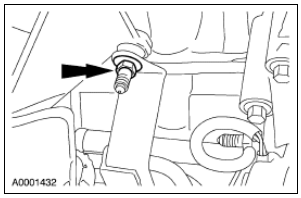
69. Disconnect the knock sensor (KS) electrical connector.



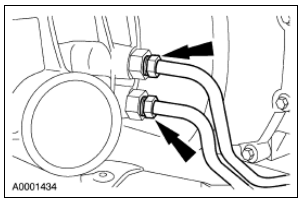
70. Disconnect the heater hose.



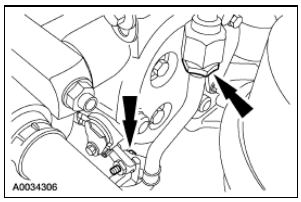
71. Remove the transmission cooler tube bracket.



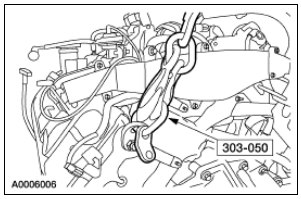
72. Disconnect the transmission cooler tubes.



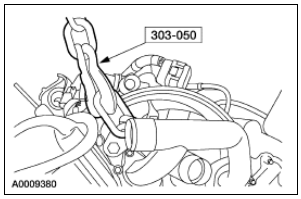
73. Disconnect the power steering pressure hose bracket bolt and disconnect the high pressure power steering hose.



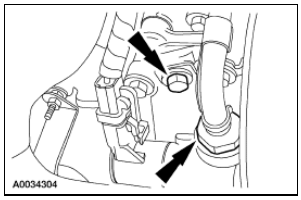
74. Install the special tool.



75. Install the special tool.



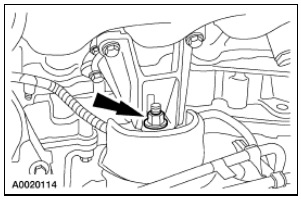
76. Remove the hydraulic fan pump bracket bolt and disconnect the hydraulic fan high pressure hose.



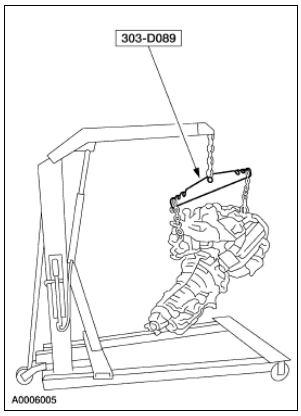
77. Using the special tool and an engine crane, support the engine and transmission in the front subframe.

78. **NOTE:** LH shown; RH similar.

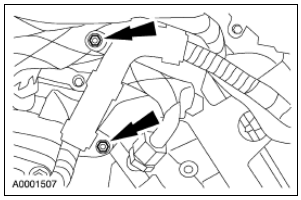
    Remove the LH and the RH upper engine mount nuts.



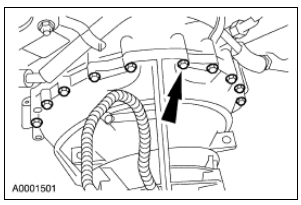
79. Using the special tool and an engine crane, move the engine and transmission from the subframe to rest on the floor or on a bench.



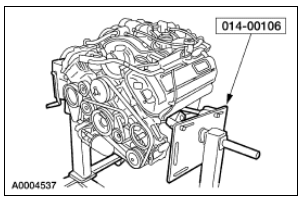
80. Remove the nuts and position the wiring harness aside.



81. Remove the bolts and separate the engine from the transmission.



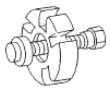
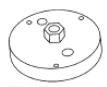
82. Mount the engine on an engine stand.



83. Remove the engine lifting equipment.

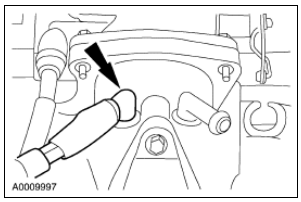
Engine

Special Tool(s)

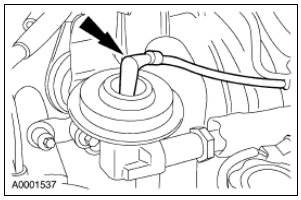
 ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
 ST2495-B	Remover/Installer, Crankshaft Rear Oil Seal 303-647
 ST2441-A	Adapter for 204-185 204-208 (T95T-5310-AR2)

Disassembly

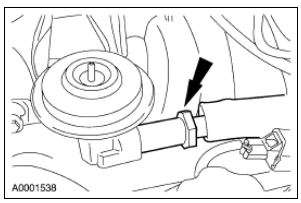
1. Disconnect the vacuum harness.



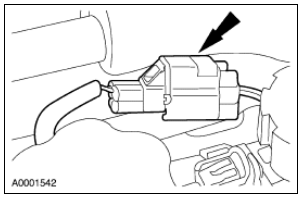
2. Disconnect the vacuum hose.



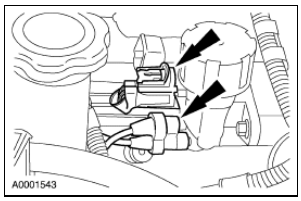
3. Remove the exhaust manifold to exhaust gas recirculation (EGR) valve tube.
   - Disconnect the upper fitting.
   - Disconnect the hoses.
   - Disconnect the lower fitting.



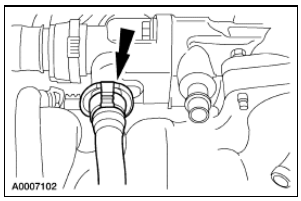
4. Disconnect the camshaft position (CMP) sensor electrical connector and separate the connector from the fuel injection supply manifold.



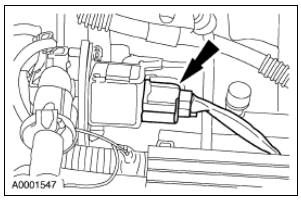
5. Disconnect the EGR vacuum regulator (EVR) electrical connector and the vacuum hose.



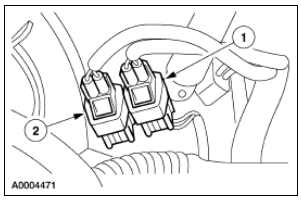
6. Disconnect the air assist tube.



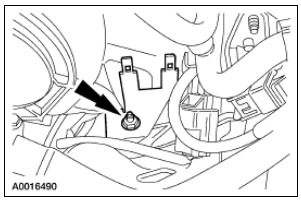
7. Disconnect the fuel pressure sensor electrical connector.



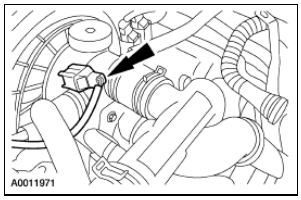
8. Remove the electrical connectors from the bracket.
    1. LH knock sensor (KS).
    2. Cylinder head temperature (CHT) sensor.



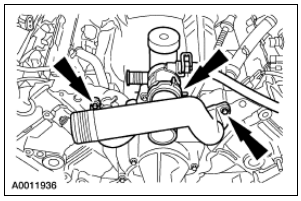
9. Remove the nut and the bracket.



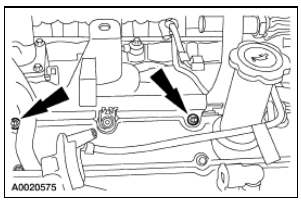
10. Disconnect the RH KS and remove the electrical connector from the bracket.



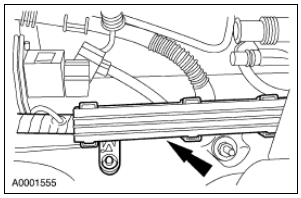
11. Remove the four bolts. Disconnect the hoses and remove the coolant outlet pipe.



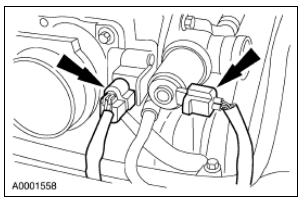
12. Remove the two nuts and the bracket.



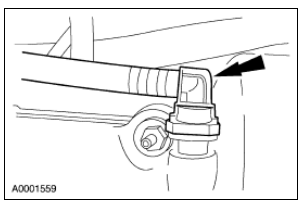
13. Raise the engine wiring harness and disconnect the LH fuel injector connectors.



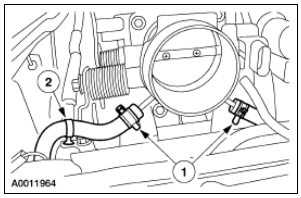
14. Disconnect the idle air control (IAC) valve and the throttle position sensor (TPS) electrical connectors.



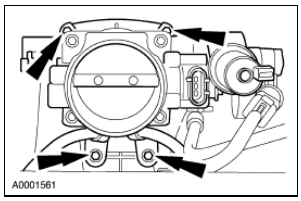
15. Disconnect the PCV tube.



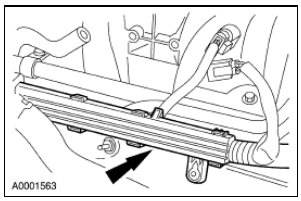
16. Disconnect the hoses (1) from the throttle body and the clip (2).



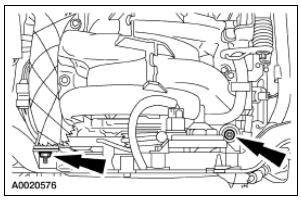
17. Remove the throttle body.



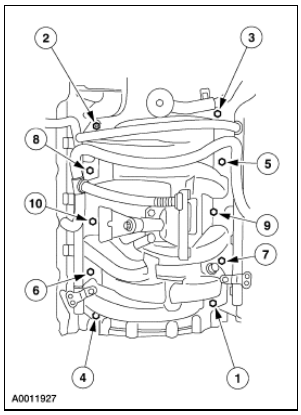
18. Raise the engine wiring harness and disconnect the RH fuel injectors.



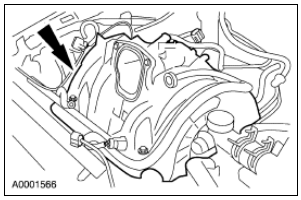
19. Remove the nuts and position the wiring harness aside.



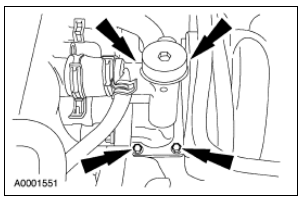
20. Remove the nine bolts and one stud (2) in the sequence shown.



21. Remove the intake manifold.

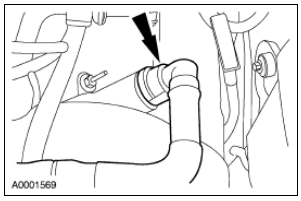


22. Remove the four bolts and the thermostat housing.

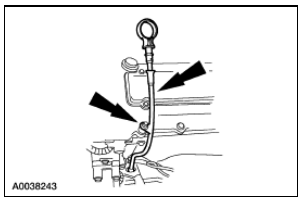


23. ⚠ **CAUTION: To remove Norma fittings, squeeze the tabs and pull straight out or damage to the fitting may occur.**

    Disconnect the crankcase ventilation tube.

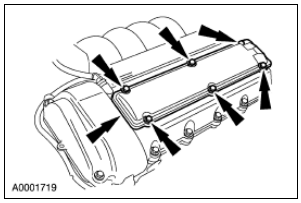


24. Remove the nut and the oil level indicator and tube.



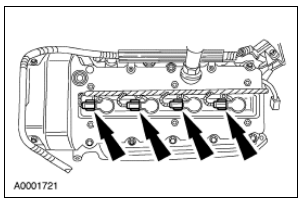
25. **NOTE:** LH shown; RH similar.

    Remove the RH and LH coil covers.



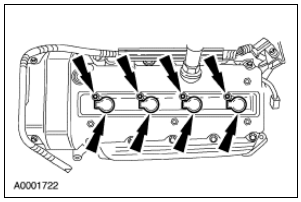
26. **NOTE:** LH shown; RH similar.

    Disconnect the RH and LH ignition coil connectors.

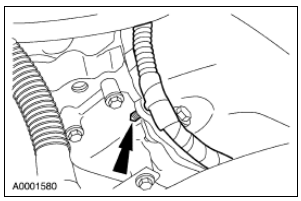


27. **NOTE:** LH shown; RH similar.

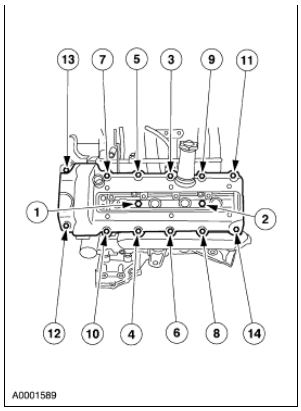
    Remove the RH and LH ignition coils.



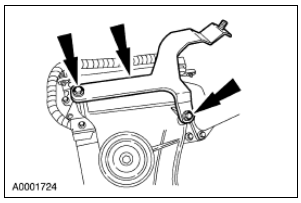
28. Disconnect the wiring harness retainers from the LH valve cover.



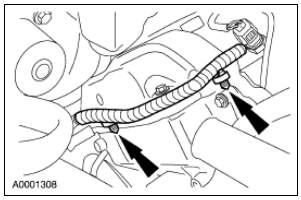
29. Remove the bolts in the sequence shown and remove the LH valve cover.



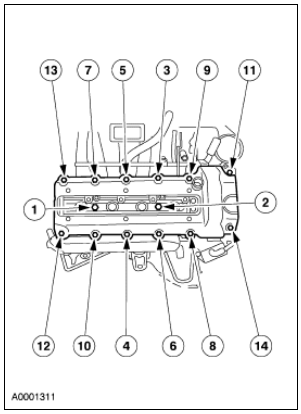
30. Remove the bracket.



31. Disconnect the three wiring harness retainers from the RH valve cover.



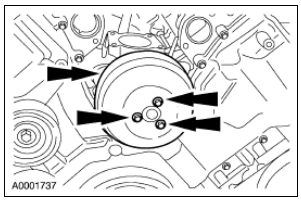
32. Remove the bolts in the sequence shown and remove the RH valve cover.



33. Loosen the water pump pulley bolts.

34. Remove the drive belt and tensioner. For additional information, refer to Section 303-05 .

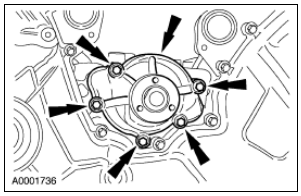
35. Remove the water pump pulley.
    - Remove and discard the bolts.
    - Remove the pulley.



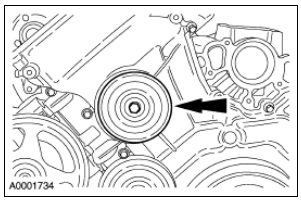
36. **⚠ CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of the gasket.**

    Remove the water pump.

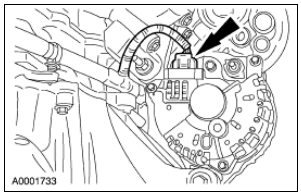
    - Remove the bolts.
    - Remove the water pump.
    - Discard the gasket.
    - Clean and inspect the O-ring seal. Install a new seal if necessary.



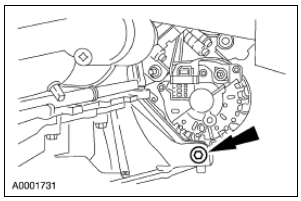
37. Remove the two idler pulleys.



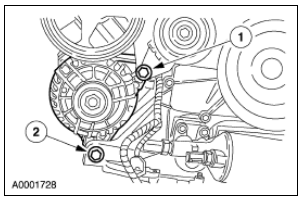
38. Disconnect the electrical connector at the rear of the generator.



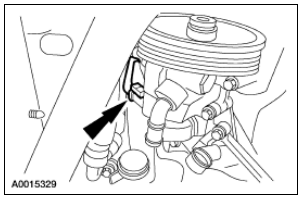
39. Remove the bolt.



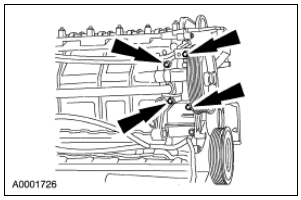
40. Remove the generator.
    1. Remove the upper bolt.
    2. Remove the lower bolt.



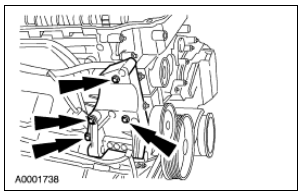
41. Disconnect the electrical connector.



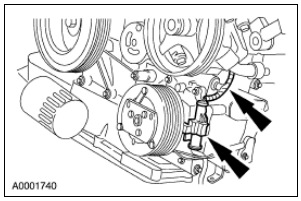
42. Remove the hydraulic cooling fan pump.



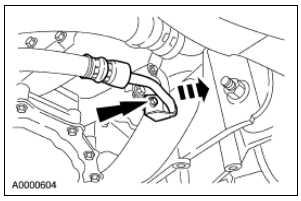
43. Remove the hydraulic pump bracket.



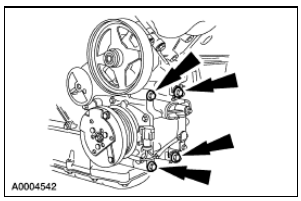
44. Disconnect the A/C electrical connector and the retaining clip.



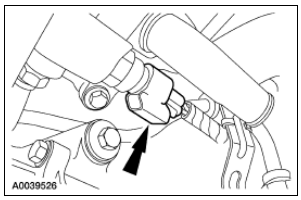
45. Remove the two power steering hose brackets.



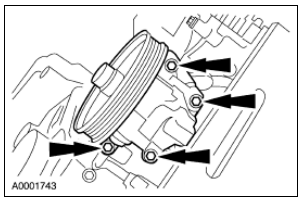
46. Remove the A/C compressor (19703).



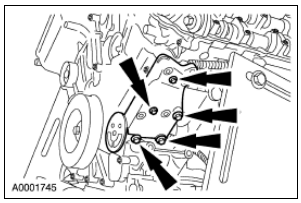
47. Disconnect the power steering pressure (PSP) switch.



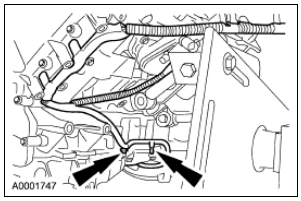
48. Remove the power steering pump.



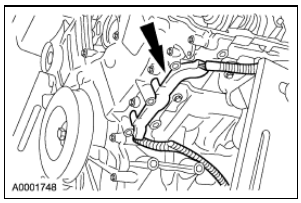
49. Remove the power steering pump bracket.



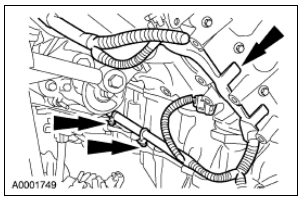
50. Disconnect the two pin-type retainers.



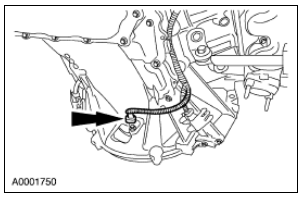
51. Remove the wiring harness from the front cover.



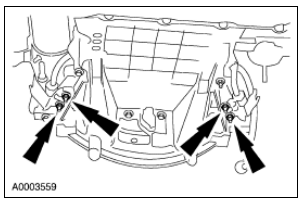
52. Remove the wiring harness from the front cover.



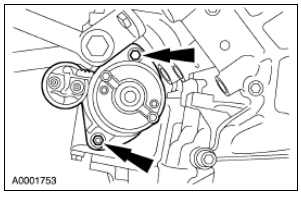
53. Disconnect the crankshaft position (CKP) sensor electrical connector.



54. Remove the exhaust gas oxygen sensor (HO2S) connectors from the brackets.

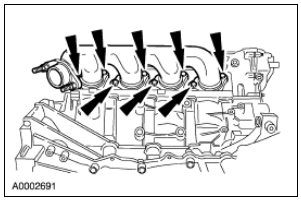


55. Remove the starter motor.

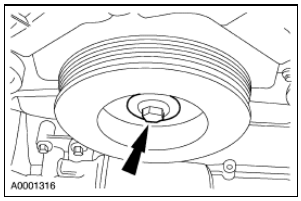


56. **NOTE:** RH shown; LH similar.

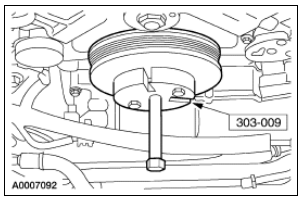
Remove the RH and LH exhaust manifolds.



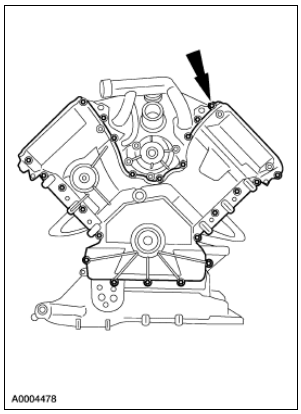
57. Remove the bolt and washer.
    - Discard the bolt.



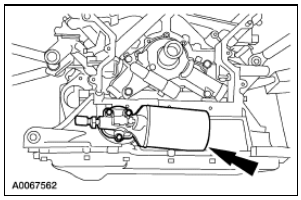
58. Using the special tool, remove the crankshaft damper.



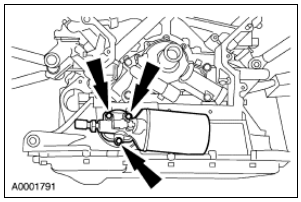
59. Remove the bolts and remove the front cover.



60. Remove and discard the oil filter.

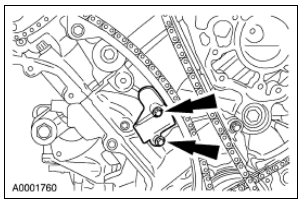


61. Remove the oil filter adapter.
    - Discard the seal.

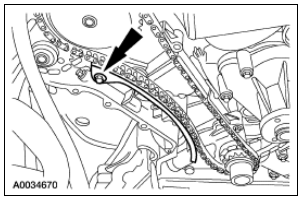


62. Turn the crankshaft to 45 degrees ATDC. The crankshaft keyway will be in the 6 o'clock position.

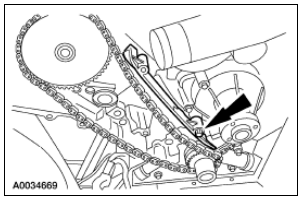
63. Remove the RH primary chain tensioner.



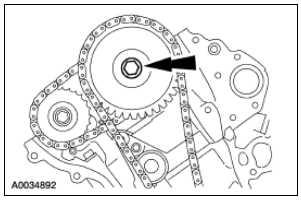
64. Remove the RH lower primary chain tensioner arm.



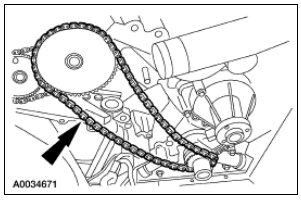
65. Remove the RH upper primary chain tensioner guide.



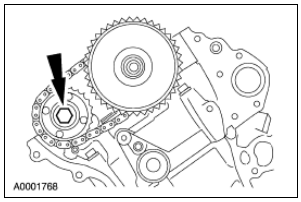
66. Remove the RH intake camshaft bolt.



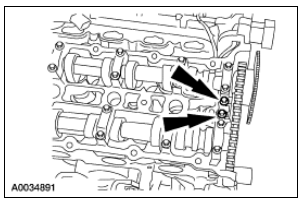
67. Remove the RH primary timing chain (6268).



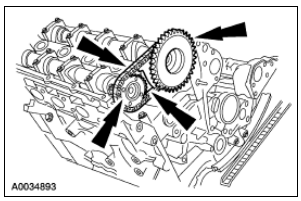
68. Remove the exhaust camshaft sprocket bolt.



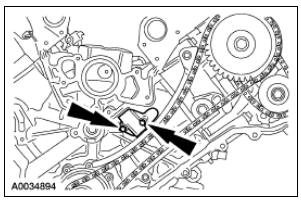
69. Remove the secondary timing chain tensioner bolts.



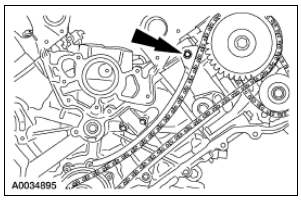
70. Remove the RH camshaft chain, tensioner and sprockets as an assembly.



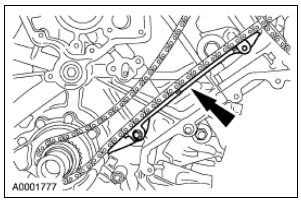
71. Remove the bolts and the LH primary chain tensioner.



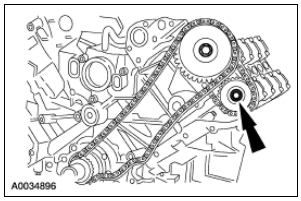
72. Remove the LH upper primary chain tensioner arm.



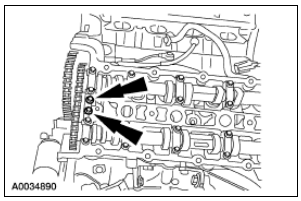
73. Remove the LH lower primary chain tensioner guide.



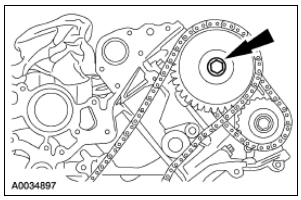
74. Remove the exhaust camshaft sprocket bolt.



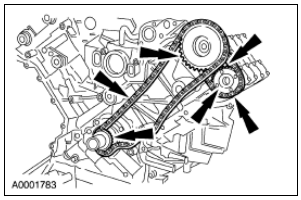
75. Remove the secondary timing chain tensioner bolts.



76. Remove the intake sprocket bolt.



77. Remove the LH camshaft chain, tensioner sprockets, primary chain and crankshaft sprocket as an assembly.

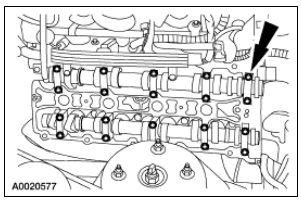


78. ⚠ **CAUTION: Mark the camshaft caps for correct location and orientation during assembly.**

NOTE: RH shown; LH similar.

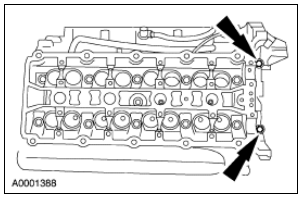
Remove the camshafts from the RH and LH cylinder heads.

- Remove the bolts.
- Remove the caps.
- Remove the camshafts.

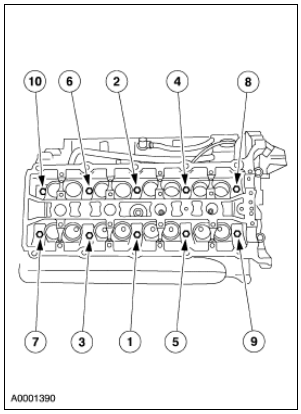


79. **NOTE:** RH shown; LH similar.

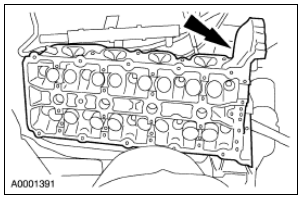
Remove and discard the bolts from the RH and LH cylinder heads.



80. Remove the bolts in the sequence shown from both cylinder heads.
    - Discard the bolts.

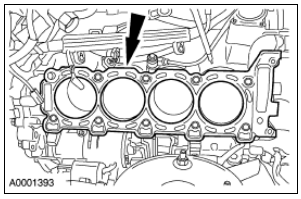


81. Remove the cylinder heads.
    - Discard the gaskets.

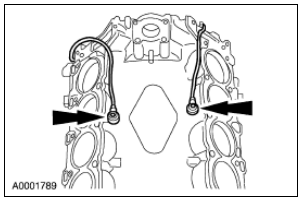


82. ⚠ **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of sealant.**

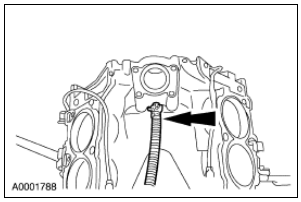
    Clean the sealing surfaces.



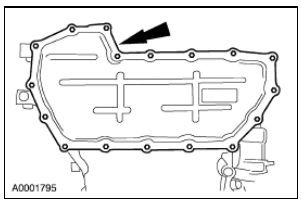
83. Remove the knock sensors.



84. Remove the throttle body heater return hose.

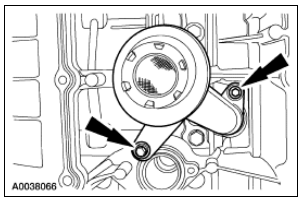


85. Remove the bolts and the oil pan.

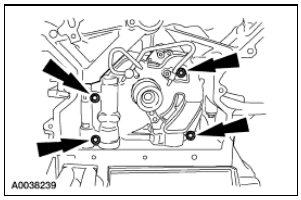


86. ⚠ **CAUTION: Use only hand tools to remove the oil pump screen and pick up tube.**

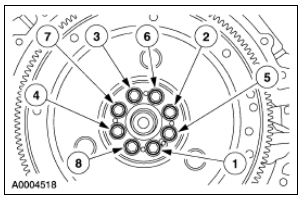
Remove the oil pump screen cover and tube, and the seal.



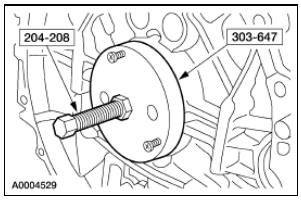
87. Remove the four bolts and the oil pump.
    - Discard the gasket.



88. Remove the flexplate.
    - Remove the bolts in the sequence shown.
    - Remove the flexplate.

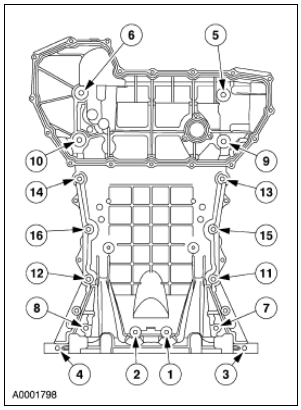


89. Using the special tool, remove the rear main seal.
    - Discard the seal.



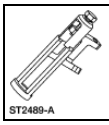
90. ⚠ **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of the sealant.**

    Remove the bolts in the sequence shown and remove the sump body.



Cylinder Head

Special Tool(s)

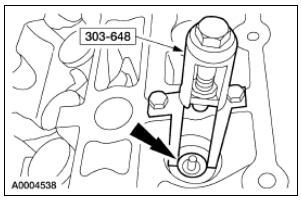
 ST2489-A	Compressor, Valve Spring 303-648

Material

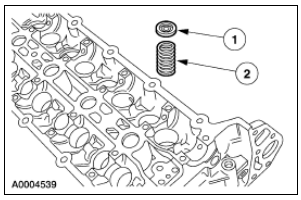
Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

Disassembly

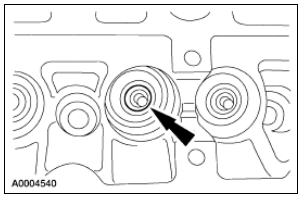
1. Using the special tool, remove the valve spring retainer keys.



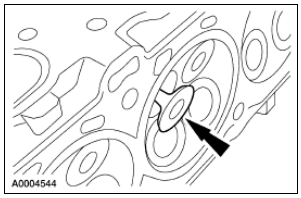
2. Remove the valve spring assemblies.
    1. Remove the valve spring retainers.
    2. Remove the valve springs.
    - For component tests for the valve spring, refer to Section 303-00 .



3. Remove the valve stem seal.



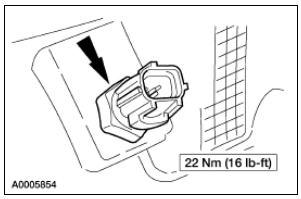
4. Remove the valve.
    - For component tests for the valve, refer to Section 303-00 .
    - For component tests for the cylinder head, refer to Section 303-00 .



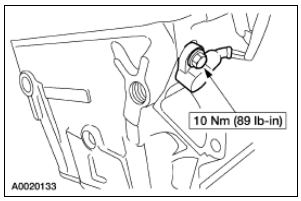
5. Repeat the procedure until all of the valves are removed from the cylinder head.

6. Remove the spark plugs. For additional information, refer to Section 303-07B .

7. Remove the cylinder head temperature sensor (CHT) sensor.



8. Remove the camshaft position (CMP) sensor.

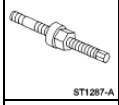
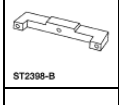
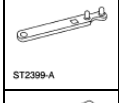
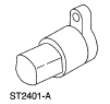
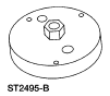
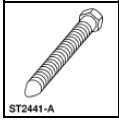


Assembly

1. To assemble, reverse the disassembly procedure.
    - Lubricate the valve stem and the valve stem seal with clean engine oil.

Engine

Special Tool(s)

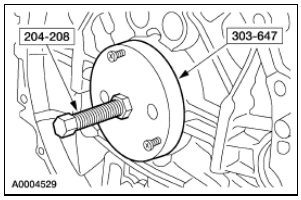
 ST2423-A	Installer, Crankshaft Front Oil Seal 303-646
 ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST2398-B	Aligner, Camshaft 303-530
 ST2399-A	Tensioner, Timing Chain 303-532
 ST2401-A	Alignment Gauge, Crankshaft 303-645
 ST2495-B	Remover/Installer, Crankshaft Rear Oil Seal 303-647
 ST2441-A	Adapter for 204-185 204-208 (T95T-5310-AR2)

Material

Item	Specification
Motorcraft Premium Gold Engine Coolant VC-7-A or equivalent	WSE-M97B51-A1
Motorcraft Premium Engine Coolant VC-4-A or equivalent	ESE-M97B44-A
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H
Silicone Gasket and Sealant F7AZ-19554-EA (in Canada CXC-111-A) or equivalent	WSE-M4G323-A4
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A

1. **NOTE:** Lubricate the outer lips and the inner seal on the crankshaft rear oil seal with clean engine oil.

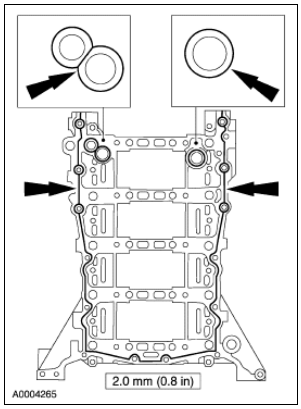
   Using the special tool, install the rear main seal.



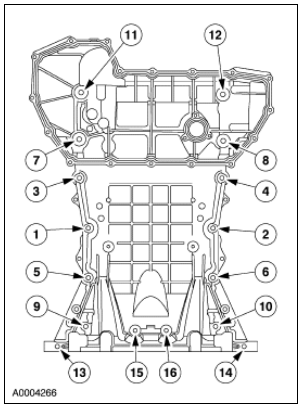
2. ⚠ **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs, or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

   NOTE: If the sump is not secured within four minutes of sealant application the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

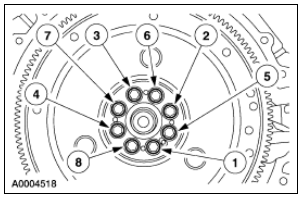
   Apply three continuous beads of sealer of silicone gasket and sealant.



3. Install the oil sump. Using a straightedge, align the sump to the lower cylinder block. Tighten the bolts in sequence in two stages.
   - Tighten the bolts to 15 Nm (11 lb-ft).
   - Tighten the bolts to 25 Nm (18 lb-ft).



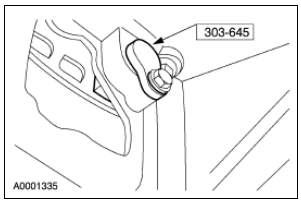
4. Install the flexplate and tighten the bolts in two stages in the sequence shown.
   - Stage 1: Tighten to 15 Nm (11 lb-ft).
   - Stage 2: Tighten to 110 Nm (81 lb-ft).



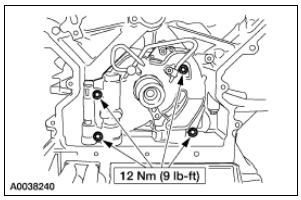
5. **NOTE:** There is one window on the ignition pulse wheel that is unique to accept the special tool.

   Install the special tool.

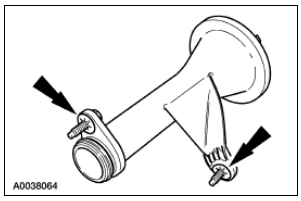
   - Turn the crankshaft to 45 degrees ATDC. The crankshaft keyway will be in the 6 o'clock position.
   - Install the special tool.



6. Install a new gasket, the oil pump and the bolts.

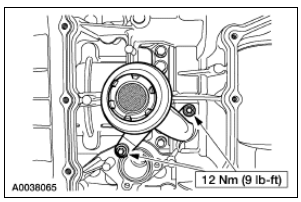


7. Verify the retaining washers are in place.



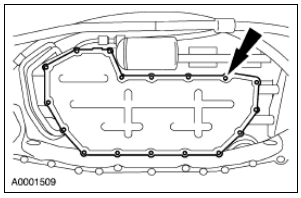
8. **NOTE:** Inspect the O-ring. Install a new O-ring if necessary. Lubricate the O-ring with clean engine oil.

   Install the oil pump screen cover and tube.

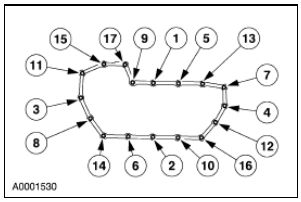


9. **NOTE:** Inspect and install a new oil pan gasket if necessary.

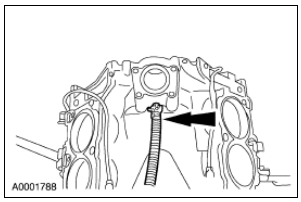
   Install the oil pan.



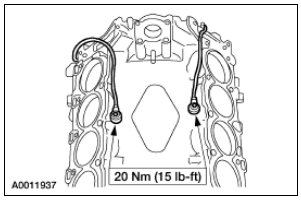
10. Tighten the bolts in the sequence shown in two stages.
    - Stage 1: Tighten to 5 Nm (44 lb-in).
    - Stage 2: Tighten to 12 Nm (9 lb-ft).



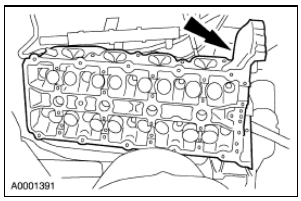
11. Install the throttle body heater return hose.



12. Install the knock sensors.



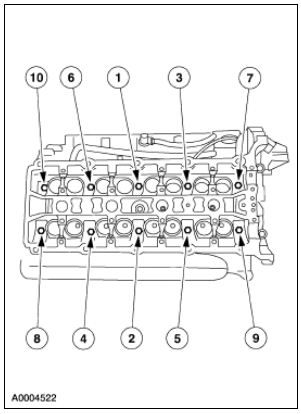
13. Position the cylinder heads.
    - Install new gaskets.



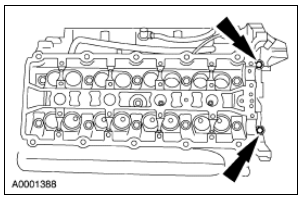
14. **NOTE:** The cylinder head bolts are a torque-to-yield design and must not be reused. Always use new bolts.

    Install and tighten the RH head bolts in six stages in the sequence shown.

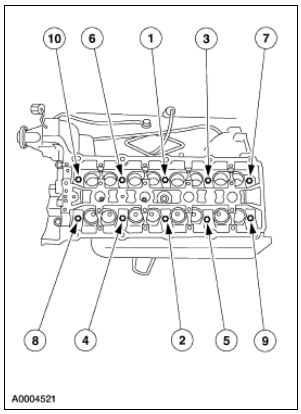
    - Stage 1: Tighten bolts 1 through 10 to 20 Nm (15 lb-ft).
    - Stage 2: Tighten bolts 1 through 10 to 35 Nm (26 lb-ft).
    - Stage 3: Tighten bolts 1 through 10 to 45 Nm (33 lb-ft) and an additional 90 degrees.
    - Stage 4: Tighten bolts 1 through 10 an additional 90 degrees.
    - Stage 5: Tighten bolts 11 and 12 to 20 Nm (15 lb-ft).
    - Stage 6: Tighten bolts 11 and 12 an additional 90 degrees.



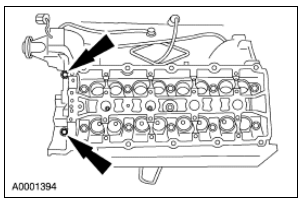
15. Install and tighten the bolts in two stages.
    1. Tighten to 20 Nm (15 lb-ft).
    2. Tighten an additional 90 degrees.



16. Install and tighten the LH head bolts in six stages in the sequence shown.
    - Stage 1: Tighten bolts 1 through 10 to 20 Nm (15 lb-ft).
    - Stage 2: Tighten bolts 1 through 10 to 35 Nm (26 lb-ft).
    - Stage 3: Tighten bolts 1 through 10 to 45 Nm (33 lb-ft) and an additional 90 degrees.
    - Stage 4: Tighten bolts 1 through 10 an additional 90 degrees.
    - Stage 5: Tighten bolts 11 and 12 to 20 Nm (15 lb-ft).
    - Stage 6: Tighten bolts 11 and 12 an additional 90 degrees.



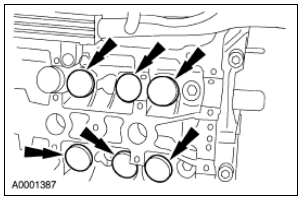
17. Install and tighten the bolts in two stages.
    1. Tighten to 20 Nm (15 lb-ft).
    2. Tighten an additional 90 degrees.



18. ⚠ **CAUTION: The shim and tappets are location-specific. They must be installed in their original locations or shims will have to be reselected during installation.**

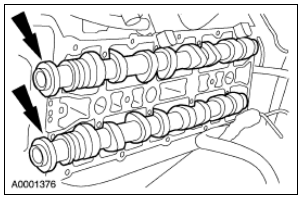
    ⚠ **CAUTION: Do not use any means of marking the shims other than a permanent type marker. Any scratches or paint on the shims can result in incorrect lash adjustments and severe engine damage.**

    If removed, install the tappets and shims. If new tappets and shims are to be installed or if they cannot be identified, refer to Valve Clearance Adjustment in this section.



19. **NOTE:** Apply clean engine oil to the camshaft journals, the camshaft caps and the camshaft lobes prior to installing the camshafts.

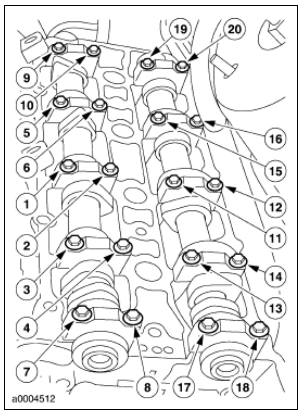
    Position the LH camshafts on the camshaft journals.



20. ⚠ **CAUTION: Install the camshaft bearing cap locations. The camshaft bearing caps are positional and must be installed in their original locations and orientation or engine damage can occur.**

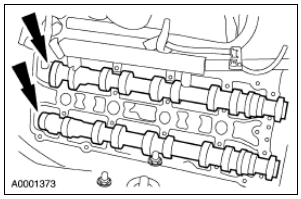
    Install the LH camshaft bearing caps.

    - Position the bearing caps.
    - Install the bolts. Tighten the bolts in three stages in the sequence shown.
        - ♦ Stage 1: Hand-tighten.
        - ♦ Stage 2: Tighten to 6 Nm (53 lb-in).
        - ♦ Stage 3: Tighten an additional 90 degrees.



21. **NOTE:** Apply clean engine oil to the camshaft journals, the camshaft caps and the camshaft lobes prior to installing the camshafts.

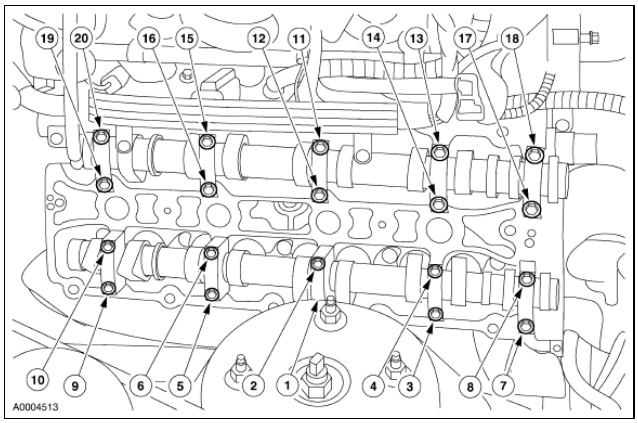
Position the RH camshafts on the camshaft journals.



22. ⚠ **CAUTION: Install the camshaft bearing caps in their original locations. The camshaft bearing caps are positional and must be installed in their original locations and orientations or engine damage can occur.**

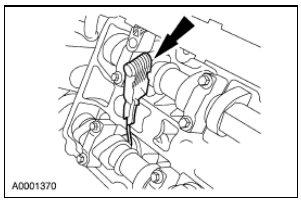
    Install the RH camshaft bearing caps.

    - Position the bearing caps.
    - Install the bolts. Tighten the bolts in three stages in the sequence shown.
        - ♦ Stage 1: Hand-tighten.
        - ♦ Stage 2: Tighten to 6 Nm (53 lb-in).
        - ♦ Stage 3: Tighten an additional 90 degrees.



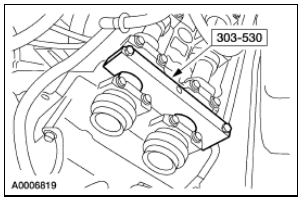
23. **NOTE:** The crankshaft must be at 45 degrees ATDC with crankshaft position tool installed.

    Using a feeler gauge, confirm that the bucket tappet and shim clearances are within specification.

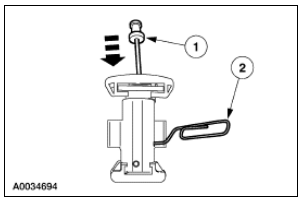


24. **NOTE:** LH shown; RH similar.

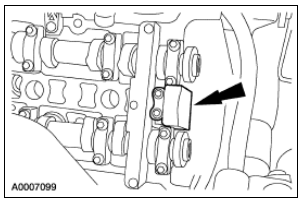
    Install the special tool on the LH head.



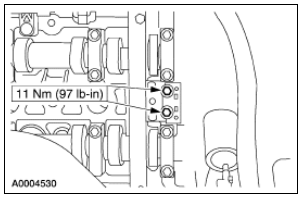
25. Collapse the tensioners.
    1. Insert a thin wire into the check valve and apply hand pressure until the tensioner is fully collapsed.
    2. Install a wire in the side to retain the tensioner.



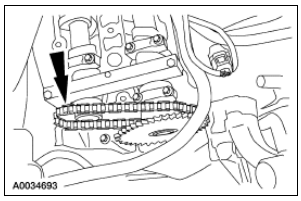
26. Position the tensioner.



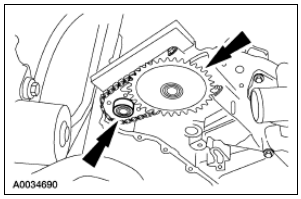
27. Install the secondary timing chain tensioner bolts.



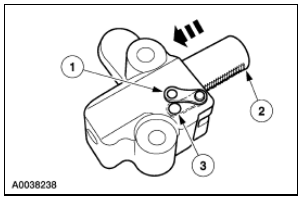
28. Position the intake sprocket, chain and exhaust sprocket on the camshaft as an assembly.



29. Loosely install the intake and exhaust sprocket bolts.



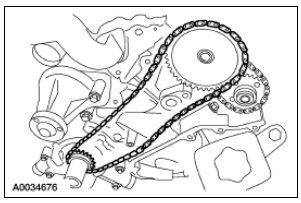
30. Reset the timing chain tensioner.
    1. Hold the lever toward the tensioner piston.
    2. Using finger pressure, compress the tensioner.
    3. Push the lever down and install a drill rod to lock the piston.



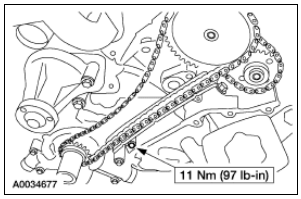
31. **NOTE:** The special tool should still be installed on the LH cylinder head.

    Position the LH timing chain and crankshaft gear.

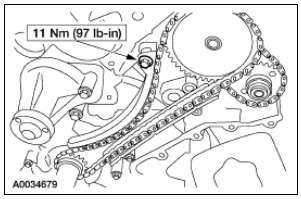
    - Position the timing chain over the LH intake camshaft sprocket.
    - Position the crankshaft gear in the timing chain.
    - Position the timing chain and crankshaft gear over the crankshaft as an assembly.



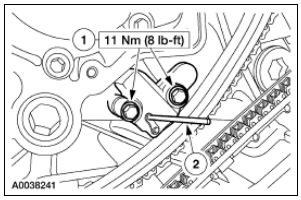
32. Install the LH timing chain guide.



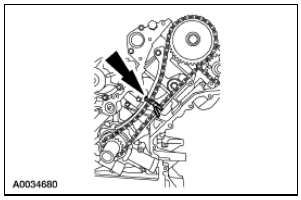
33. Install the LH timing chain tensioner arm.



34. Install the LH timing chain tensioner.
    1. Install the timing chain tensioner and bolts.
    2. Remove the drill rod.



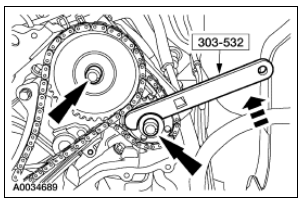
35. Install a tie strap to take up the slack in the timing chain.



36. **NOTE:** The exhaust camshaft sprocket bolt must be fully tightened before tightening the intake camshaft sprocket bolt.

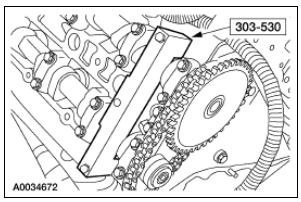
    Using the special tool, apply 10Nm(89 lb-in) counterclockwise to the LH exhaust camshaft sprocket and tighten the camshaft sprocket bolts in two stages.

    - Stage 1: Tighten to 20 Nm (15 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.

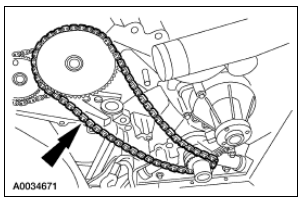


37. Remove the special tool.

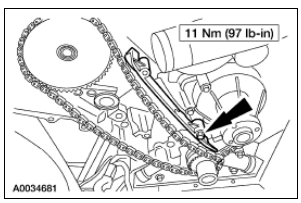
38. Install the special tool on the right cylinder head.



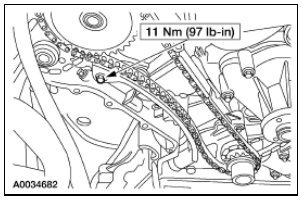
39. Position the RH timing chain over the RH intake camshaft sprocket and over the crankshaft gear.



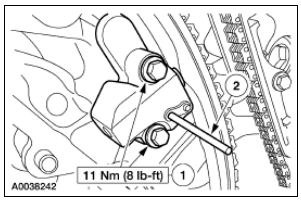
40. Install the RH timing chain guide.



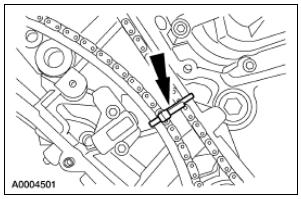
41. Install the RH timing chain tensioner arm .



42. Install the RH timing chain tensioner.
    1. Install the timing chain tensioner and bolts.
    2. Remove the drill rod.



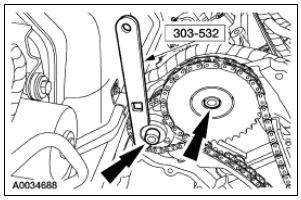
43. Install a tie strap to take up the slack in the timing chain.



44. **NOTE:** The exhaust camshaft sprocket bolt must be fully tightened before tightening the intake camshaft sprocket bolt.

    Using the special tool, apply 10Nm(89 lb-in) counterclockwise to the RH camshaft sprockets and tighten the bolts in two stages.

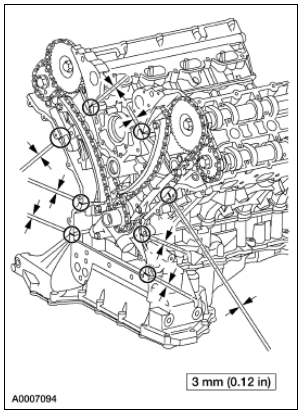
    - Stage 1: Tighten to 20 Nm (15 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.



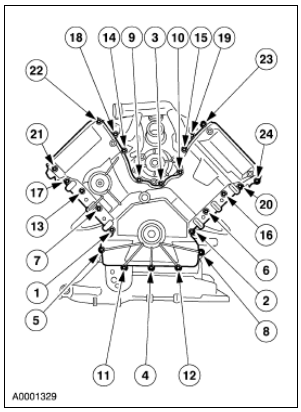
45. Remove the special tool and the two tie straps.

46. **NOTE:** If the front cover is not secured within four minutes of sealant application the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

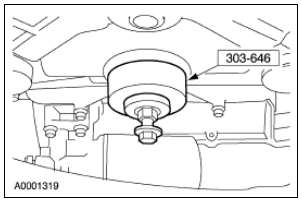
    Apply silicone gasket and sealant in eight places.



47. Install the engine front cover.
    - Install new gaskets.
    - Position the engine front cover on the cylinder block.
    - Loosely install the bolts.
    - Tighten the bolts in two stages in the sequence shown.
        - ♦ Stage 1: Tighten to 5 Nm (44 lb-in).
        - ♦ Stage 2: Tighten to 10 Nm (89 lb-in).

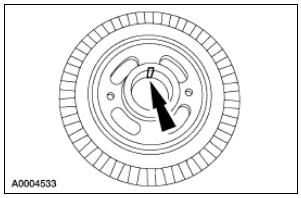


48. Using the special tool, install the front crankshaft seal.

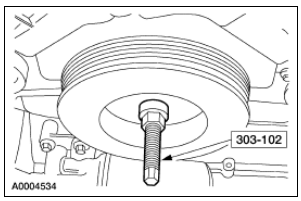


49. **NOTE:** If the crankshaft pulley is not secured within four minutes of sealant application the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

    Apply silicone gasket and sealant to the crankshaft pulley keyway.

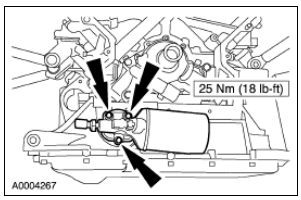


50. Using the special tool, install the crankshaft pulley.

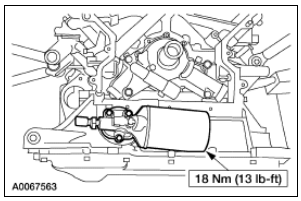


51. Install the washer and a new bolt and tighten in two stages.
    - Stage 1: Tighten to 80 Nm (59 lb-ft).
    - Stage 2: Tighten an additional 80 degrees.
    - Remove the flexplate holding tool.

52. Install a new seal and the oil filter adapter.



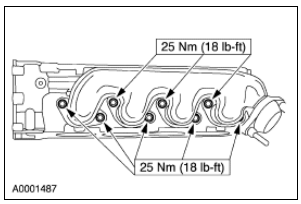
53. Install the oil filter.
    - Install the oil filter until the seal makes contact.
    - Tighten an additional 270 degrees.



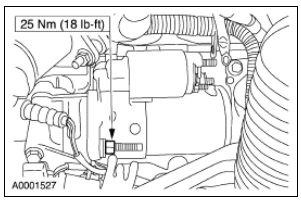
54. **NOTE:** The gaskets are marked top to aid in installation.

    NOTE: LH shown; RH similar.

    Install the new exhaust manifold gaskets and the exhaust manifolds.



55. Install the starter motor.

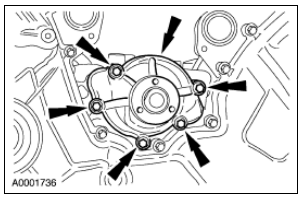


56. **NOTE:** Lubricate the water pump O-ring seal with engine coolant. Use the same coolant that was

drained from the engine.

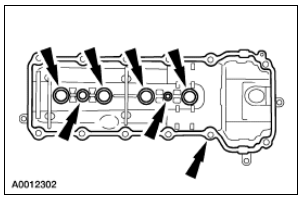
Install the water pump.

- Inspect the O-ring seal and install a new O-ring seal as necessary.
- Position a new water pump gasket.
- Position the water pump.
- Install the bolts and tighten in two stages.
  - ♦ Stage 1: Tighten to 8 Nm (71 lb-in).
  - ♦ Stage 2: Tighten an additional 90 degrees.



57. **NOTE:** RH shown; LH similar.

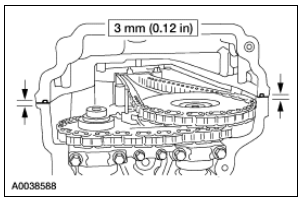
    Inspect and install new gaskets as necessary.



58. **NOTE:** RH shown; LH similar.

    NOTE: If the valve covers are not secured within four minutes of sealant application the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

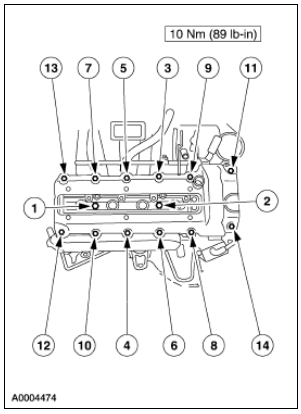
    Apply four beads of silicone gasket and sealant as shown.



59. **NOTE:** RH shown; LH similar.

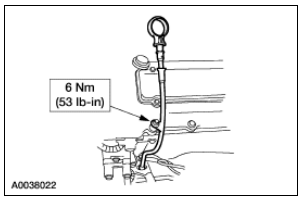
    Install the valve covers.

    - Tighten the bolts in the sequence shown.

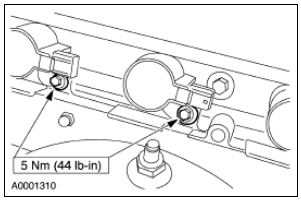


60. **NOTE:** Lubricate the O-ring with clean engine oil.

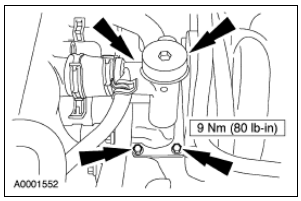
    Install the oil level indicator and tube. Install the nut.



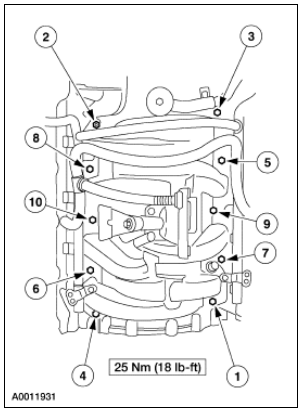
61. Install the eight ignition coils.



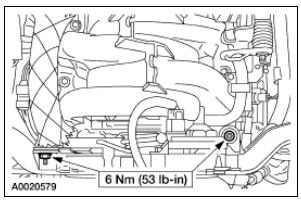
62. Install the four bolts and the thermostat housing.



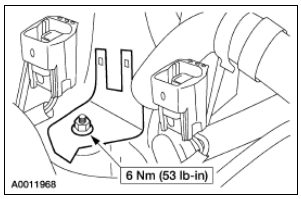
63. Install the intake manifold and tighten the bolts and stud bolt (2) in the sequence shown.
    - Inspect and install a new gasket if necessary.



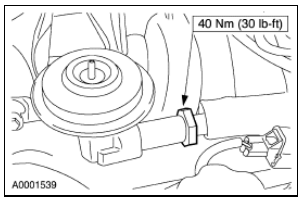
64. Position the wiring harness and install the nuts.



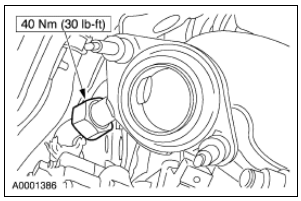
65. Install the bracket.



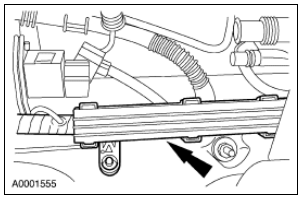
66. Install the exhaust manifold to exhaust gas recirculation (EGR) valve tube. Finger-tighten both fittings. Tighten the upper fitting.



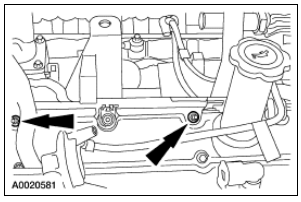
67. Tighten the lower fitting.



68. Connect the fuel injector connectors and position the engine wiring harness.

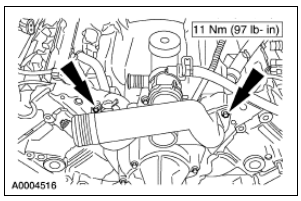


69. Install the bracket and the two nuts.

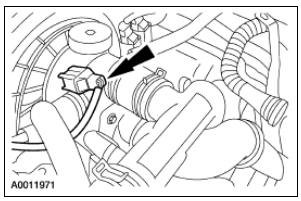


70. Install the water outlet pipe.
    - Inspect and install a new gasket if necessary.
    - Install the four bolts.

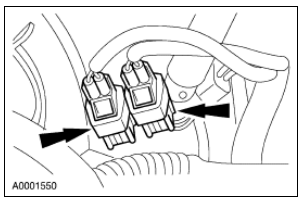
- Connect the hoses.



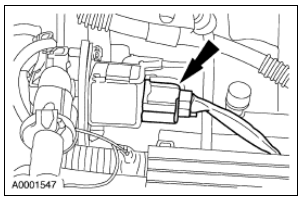
71. Connect the knock sensor connector and install onto the bracket.



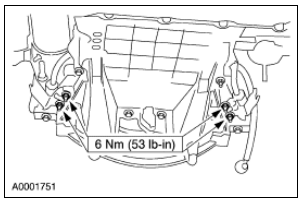
72. Install the CHT sensor and KS electrical connectors on the bracket.



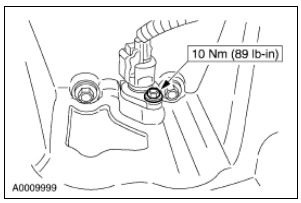
73. Connect the fuel pressure sensor electrical connector.



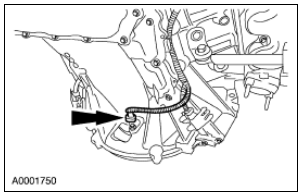
74. Connect the HO2S connectors to the brackets.



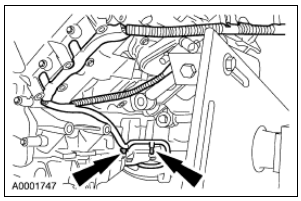
75. Remove the special tool, install the CKP sensor.



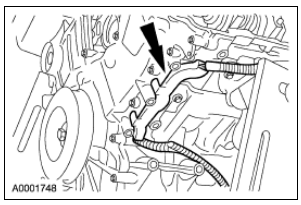
76. Connect the CKP sensor connector.



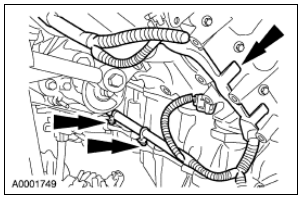
77. Connect the two pin-type retainers.



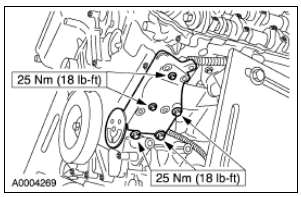
78. Install the wiring harness to the front cover on the LH side.



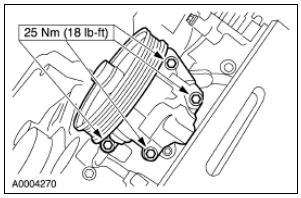
79. Install the wiring harness to the front cover on the RH side.



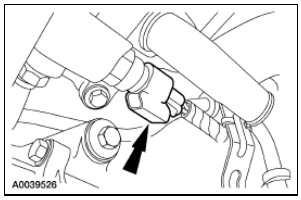
80. Install the power steering pump bracket.



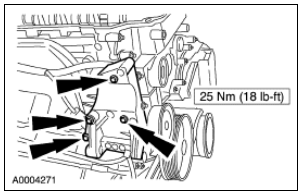
81. Install the power steering pump.



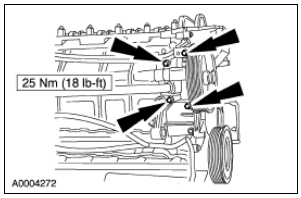
82. Connect the power steering pressure (PSP) switch.



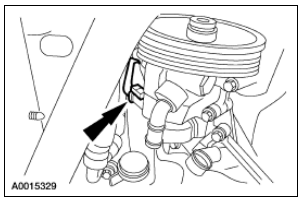
83. Install the hydraulic cooling fan pump bracket.



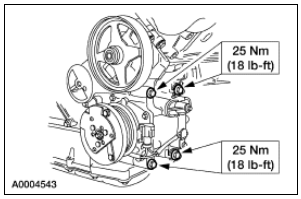
84. Install the hydraulic cooling fan pump.



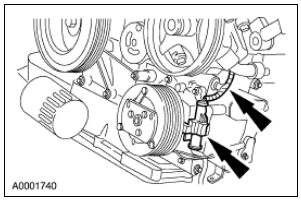
85. Connect the electrical connector.



86. Install the A/C compressor.



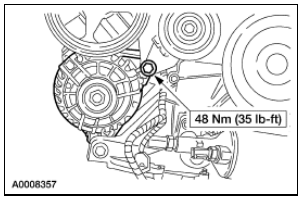
87. Connect the electrical connector and the retaining clip.



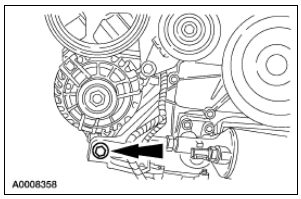
88. ⚠ **CAUTION: The generator must be installed in the order shown or damage to the drive belt can occur.**

    Position the generator and loosely install the bolts and nut.

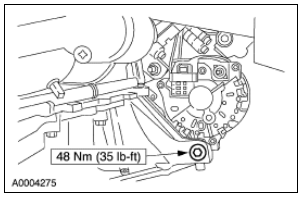
    - Tighten the upper bolt and nut.



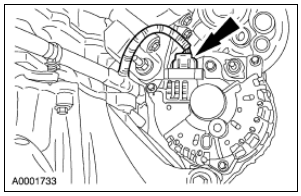
89. Tighten the lower expanding bushing and bolt in two stages.
    - Stage 1: Tighten to 20 Nm (15 lb-ft).
    - Stage 2: Tighten an additional 90 degrees.



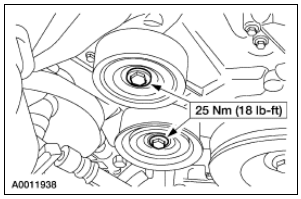
90. Tighten the bolt.



91. Connect the electrical connector.



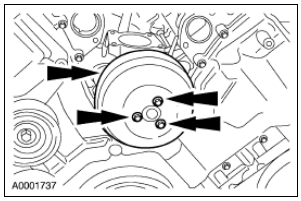
92. Install the two idler pulleys.



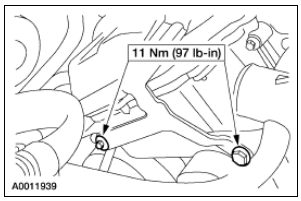
93. Position the water pump pulley and loosely install new bolts.

94. Install the drive belt tensioner. For additional information, refer to Section 303-05 .

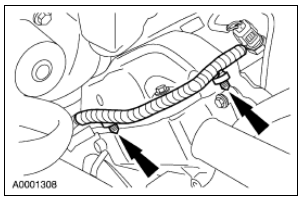
95. Tighten the water pump pulley bolts in two stages.
    - Stage 1: Tighten to 10 Nm (89 lb-in).
    - Stage 2: Tighten an additional 45 degrees.



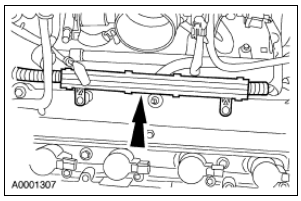
96. Install the inlet tube support bracket.



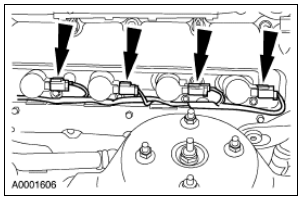
97. Install the six wiring harness retainers.



98. Connect the fuel injector connectors and position the engine wiring harness.

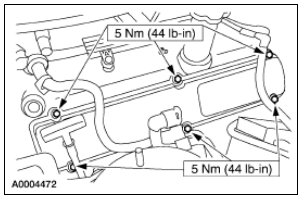


99. Connect the eight ignition coil connectors.



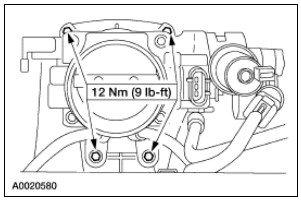
100. ⚠ **CAUTION: Make sure that the wiring harness inlet seals are seated in the valve covers or damage to the wiring harness can occur.**

Install the ignition coil covers.

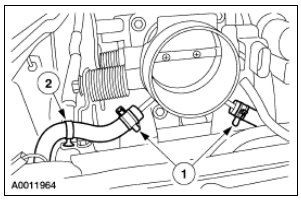


101. **NOTE:** Clean and inspect the gasket. Install a new gasket if necessary.

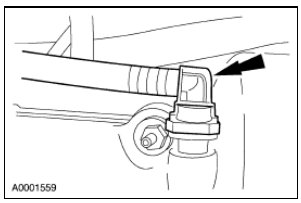
Install the throttle body.



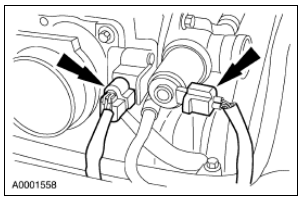
102. Connect the hoses (1) and install the hose in the clip (2).



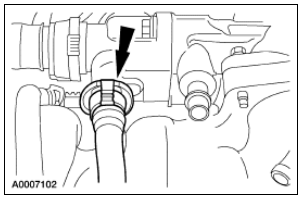
103. Connect the positive crankcase ventilation (PCV) line.



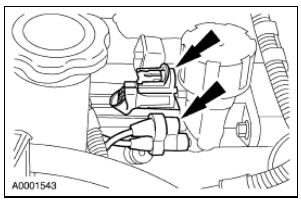
104. Connect the idle air control (IAC) and throttle position sensor (TPS) electrical connectors.



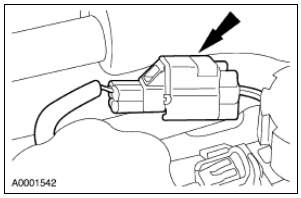
105. Connect the air assist valve hose.



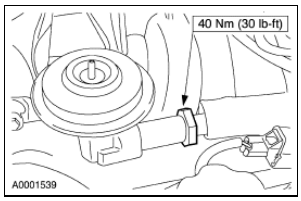
106. Connect the EGR vacuum regulator solenoid and electrical connections.



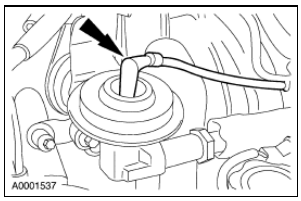
107. Connect the CMP sensor connector and connect the connector locator.



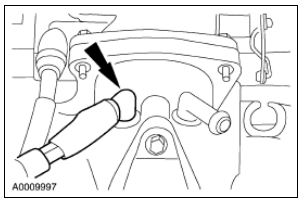
108. Connect the exhaust manifold to EGR valve tube.



109. Connect the vacuum hose.

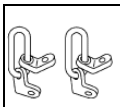


110. Connect the vacuum harness.



Engine

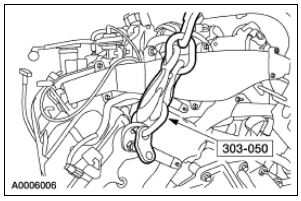
Special Tool(s)

 ST1595-A	Lifting Brackets, Engine 303-050 (T70P-6000)
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3)
 ST1444-A	Installer Set, Teflon Seal 211-D027 (D90P-3517-A) or equivalent

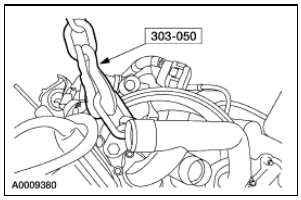
Material

Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

1. Install the special tool.



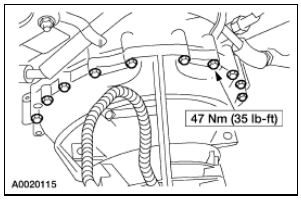
2. Install the special tool.



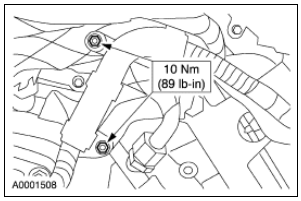
3. Using a floor crane and a spreader bar (303-D089) to support the engine, remove the engine from the engine stand.

4. **NOTE:** Align the flexplate to converter marks made at removal.

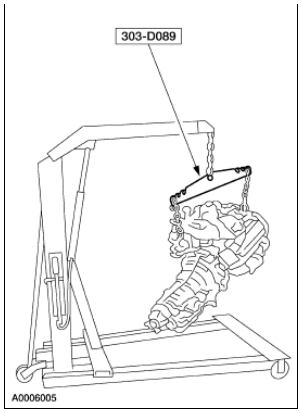
   Install the engine to the transmission and install the bolts.



5. Install the wiring harness.

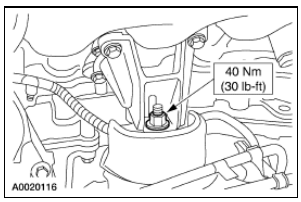


6. Using a floor crane and the special tool, install the engine onto the subframe.



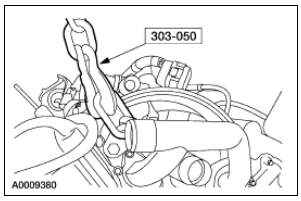
7. **NOTE:** LH shown; RH similar.

   Install the LH and the RH upper engine mounts.

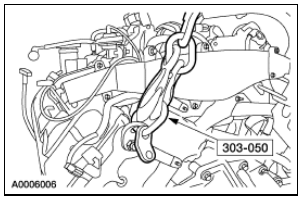


8. Remove the engine lifting equipment.

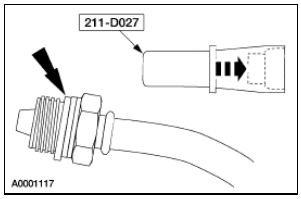
9. Remove the special tool.



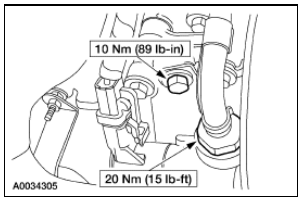
10. Remove the special tool.



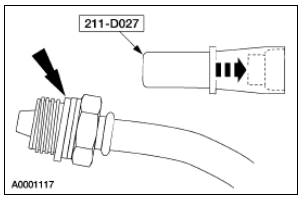
11. Install a new nylon O-ring seal on the hydraulic fan high pressure hose.



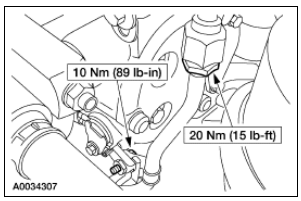
12. Install the hydraulic fan pump high pressure hose and install the hydraulic fan high pressure hose bracket bolt.



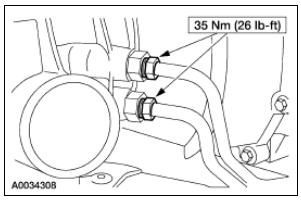
13. Install a new nylon O-ring seal on the high pressure power steering hose.



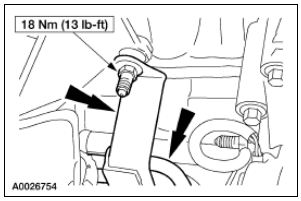
14. Install the power steering high pressure hose and power steering high pressure hose bracket bolt.



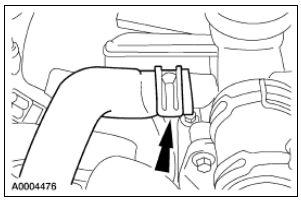
15. Connect the transmission cooler tubes.



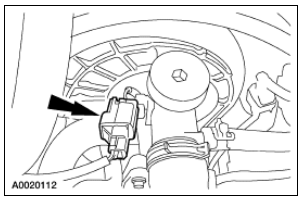
16. Install the transmission cooler tube bracket.



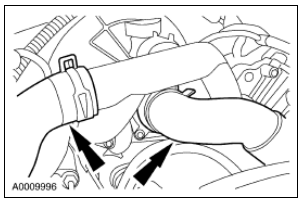
17. Connect heater hose.



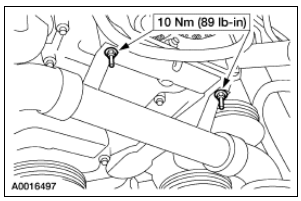
18. Connect the KS electrical connector.



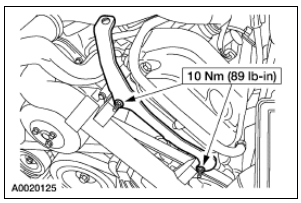
19. Connect the radiator hoses.



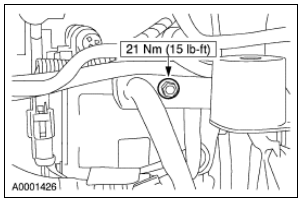
20. Install the lower radiator hose.



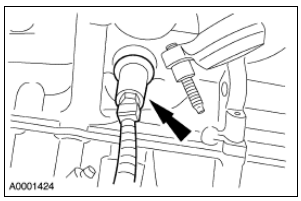
21. Install the bracket.



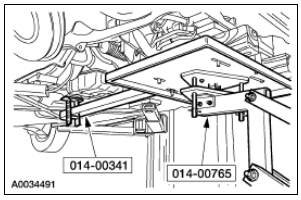
22. Connect the A/C manifold and tube.



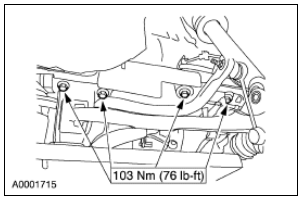
23. Connect the block heater, if equipped.



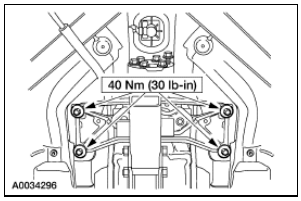
24. Using the powertrain lift and the transmission support bracket, carefully raise the entire assembly into the vehicle.



25. Install the four front and the four center crossmember bolts.

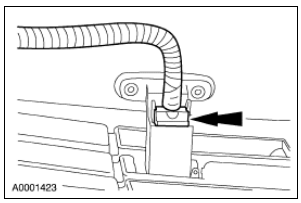


26. Install the transmission crossmember bolts.

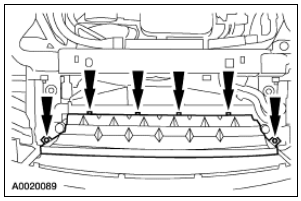


27. Remove the safety stands from the rear of the vehicle.

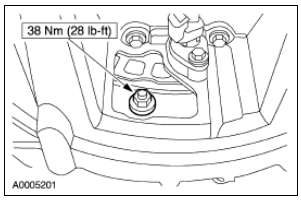
28. Install the engine block heater plug, if equipped.



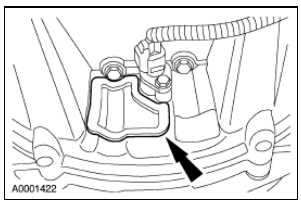
29. Install the inner air deflector.



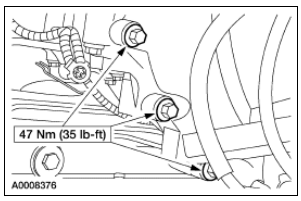
30. Install the eight torque converter nuts.



31. Install the cover.

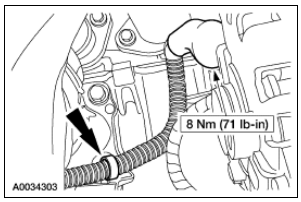


32. Install the six lower transmission to engine bolts.

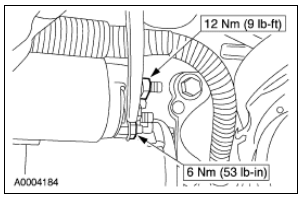


33. Install the three-way catalytic converter (TWC). For additional information, refer to Section 309-00 .

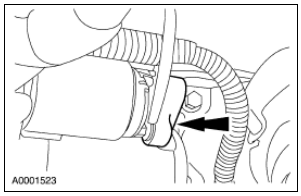
34. Connect the generator electrical connectors.



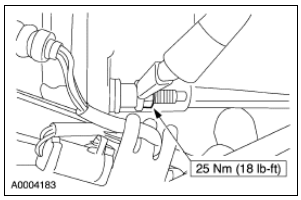
35. Connect the starter motor electrical connectors.



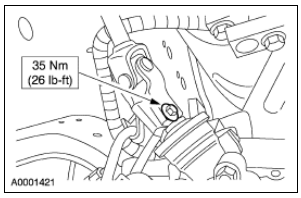
36. Install the cover.



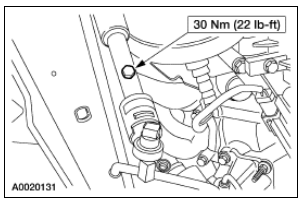
37. Install the starter motor ground cable.



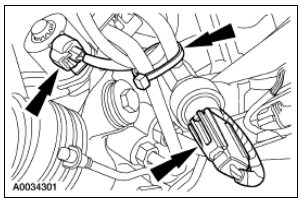
38. Connect the steering coupling.



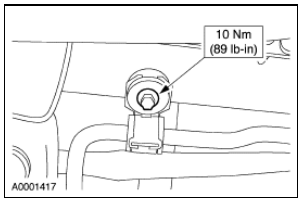
39. Install the steering shaft bolt.



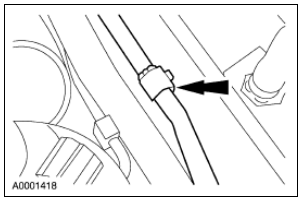
40. Connect the rack and pinion steering unit electrical connectors and install a tie-strap.



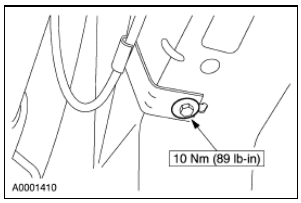
41. Install the retaining bolt for the high pressure power steering hose bracket.



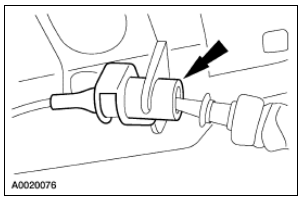
42. Install the hydraulic cooling fan return hose to the RH frame rail.



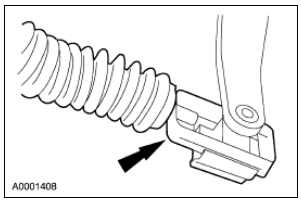
43. Install the shift cable bracket.



44. Reclip the shift cable to the bracket.

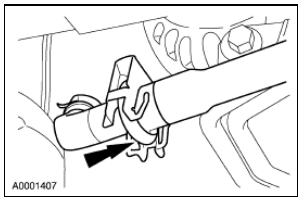


45. Connect the shift cable to the shifter.

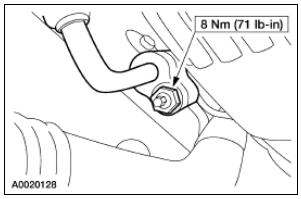


46. Install the driveshaft. For additional information, refer to Section 205-01 .

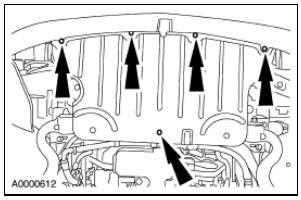
47. Connect the A/C low pressure hose.



48. Connect the A/C high pressure hose.

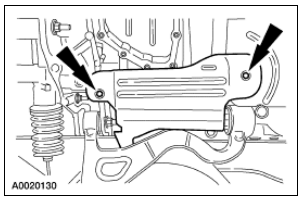


49. Install the center splash shield.



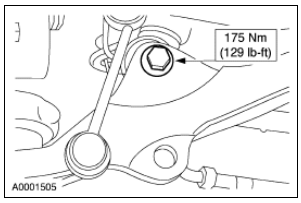
50. **NOTE:** LH shown; RH similar.

    Install the LH and the RH splash shields.



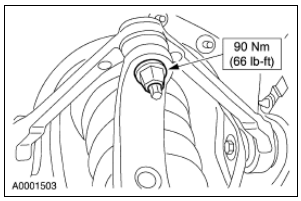
51. **NOTE:** LH shown; RH similar.

    Install the LH and the RH lower strut mount bolts.



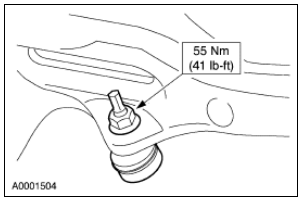
52. **NOTE:** LH shown; RH similar.

    Install the LH and the RH ball joints to the spindles and install the nuts.



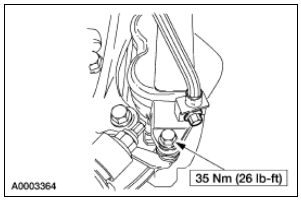
53. **NOTE:** LH shown; RH similar.

    Install the LH and the RH stabilizer bar lower nuts.



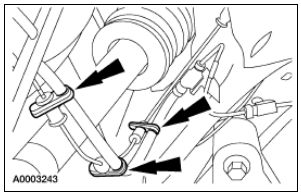
54. **NOTE:** LH shown; RH similar.

    Install the LH and the RH brake calipers.



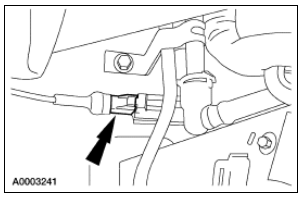
55. **NOTE:** LH shown; RH similar.

    Position the LH and the RH anti-lock brake sensor harness and reclip to the brake hoses.



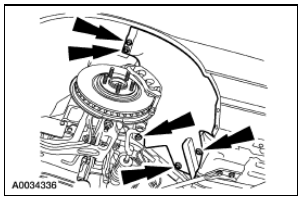
56. **NOTE:** LH shown; RH similar.

    Connect the LH and the RH anti-lock brake sensor electrical connectors.



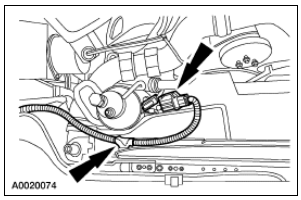
57. **NOTE:** LH shown; RH similar.

    Install the LH and the RH inner splash shields.



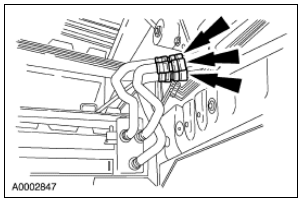
58. Install the front wheels and tires. For additional information, refer to Section 204-04 .

59. Clip the harness to the radiator support and connect the water valve electrical connector.

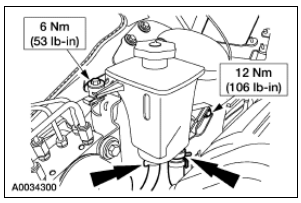


60. **NOTE:** Install the two hoses to the marks made during removal.

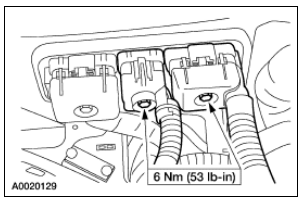
    Connect the hoses to the water control valve.



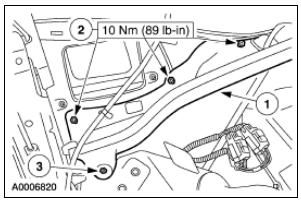
61. Connect the cooling fan hoses and install the hydraulic cooling fan reservoir.



62. Connect the connectors.

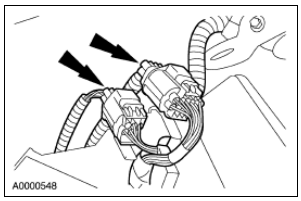


63. Install the fresh air filter panel.
    1. Position the panel.
    2. Install the nuts.
    3. Install the pin-type retainer.

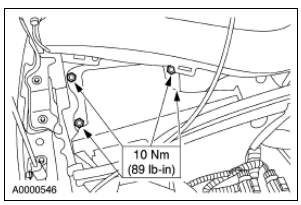


64. **NOTE:** The connectors are located on the backside of the RH strut tower.

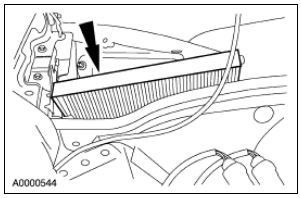
    Connect the powertrain bulkhead electrical connectors.



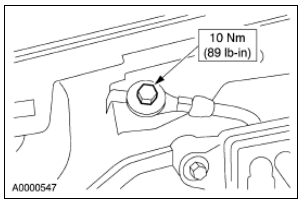
65. Install the fresh air filter housing.



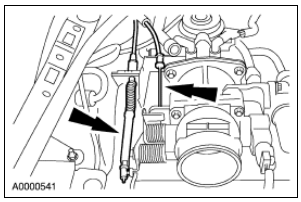
66. Install the fresh air filter.



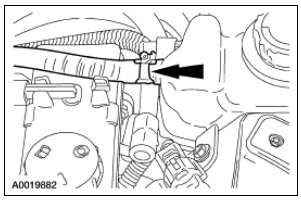
67. Connect the ground strap.



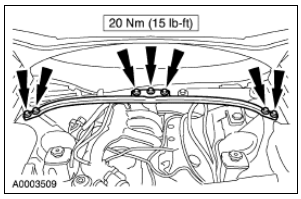
68. Connect the accelerator cable and the speed control cable.



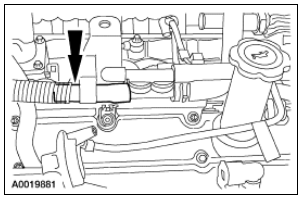
69. Connect the degas bottle hose.



70. Install the bracket.
    1. Install the bracket.
    2. Install the seven bolts and one nut.
    3. Install the windshield washer hose.

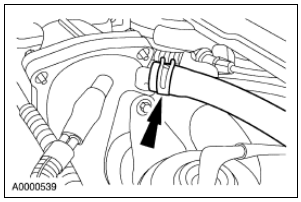


71. Reclip the hose.

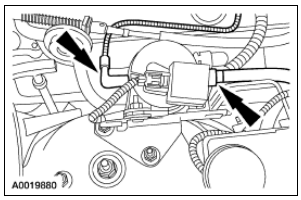


72. Install the cowl vent screen. For additional information, refer to Section 501-02 .

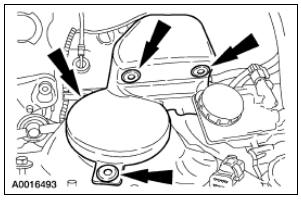
73. Connect the main vacuum supply hose.



74. Connect the VMV.
    - Vacuum hose.
    - Canister purge valve.

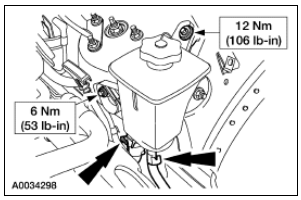


75. Install the VMV cover.

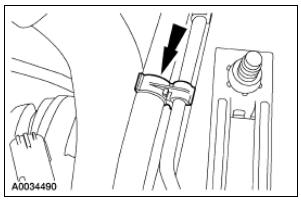


76. Connect the fuel hose. For additional information, refer to Section 310-00 .

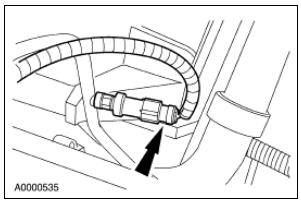
77. Connect the power steering reservoir hoses and install the power steering pump reservoir.



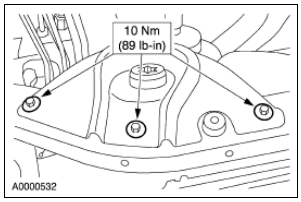
78. Attach the power steering return hose to the pressure hose clip.



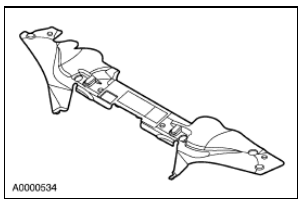
79. Connect the A/C pressure switch electrical connector.



80. Install the two upper radiator support brackets.



81. Install the upper radiator sight shield.



82. Fill the engine with clean engine oil.

83. Connect the battery ground cable. For additional information, refer to Section 414-01 .

84. Install the air cleaner assembly and outlet pipe. For additional information, refer to Section 303-12 .

85. ⚠ **CAUTION: The cooling system filling and bleeding procedure must be followed exactly or damage to the engine can occur.**

    Fill the engine cooling system. For additional information, refer to Section 303-03 .

86. Fill the power steering reservoir to the correct level. For additional information, refer to Section 211-02 .

87. Fill and bleed the hydraulic cooling fan. For additional information, refer to Section 303-03 .

88. Charge the A/C system. For additional information, refer to Section 412-00 .

General Specifications

Item	Specification
3.9L	11.3
3.0L	10.6
Cooling fan MAX speed	2,300 ± 100 rpm
Cooling fan MAX pressure output	1,200 psi
Cooling fan operating pressure	900 psi
Cooling fan operating flow rate	4.0 ± 0.25 gpm
Coolant mixture with water	50% [a]
Pressure relief cap opening pressure kPa (psi)	110 (16)
Water thermostat start to open temperature	87-93°C (192-199°F)
Water thermostat full open temperature	104°C (219°F)
Lubrication	
Premium Cooling System Flush VC-1 (in Canada CXC-86)	ESR-M14P7-A
Premium Long Life Grease XG-1-C	ESA-M1C75-B

[a] Motorcraft Premium Engine Coolant VC-4-A (in Oregon, VC-5, in Canada CXC-10) or equivalent meeting Ford specification ESE-M97B44-A (green in color) or Motorcraft Premium Gold Engine Coolant VC-7-A or equivalent meeting Ford specification WSS-M97B51-A1 (yellow in color). Do not mix coolant types.

Torque Specifications

Description	Nm	lb-ft	lb-in
Engine appearance cover bracket	10		89
Lower radiator hose	13	10	
Water outlet adapter, 3.9L	11	8	
Thermostat housing, 3.9L	11	8	
Coolant outlet pipe, 3.0L	25	18	
Coolant outlet pipe	11	8	
Water pump assembly, 3.0L	25	18	
Water pump, 3.9L [a]			
Upper radiator support brackets	10		89
Receiver/drier bracket	11	8	
Auxiliary water pump, 3.9L	10		89
Hydraulic cooling fan high pressure line	20	15	
Hydraulic cooling fan high pressure line bracket	8		71
Condenser-to-radiator bolts	10		89
Hydraulic cooling fan pump	25	18	
Hydraulic cooling fan high pressure line support bracket	13	10	
Cross vehicle support	20	15	

Degas bottle	6		53
Engine fill cap, 3.9L	9		80
Water pump pulley, 3.9L [a]			

[a] Refer to the procedure in this section.

Engine Cooling

⚠ CAUTION: Some vehicle cooling systems are filled with Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent meeting specification ESE-M97B44-A (green color). Others are filled with Mototrcraft Premium Gold Engine Coolant VC-7-A or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Always fill the cooling system with the same coolant that is present in the system. Do not mix coolant types.

The cooling system components include the:

- block heater (optional)
- cylinder head temperature sensor
- fan blade, fan motor and fan shroud assembly
- radiator
- pressure relief cap
- degas bottle
- radiator draincock
- water pump
- oil cooler (optional)
- water thermostat

The water thermostat:

- controls the engine coolant temperature.
- allows quicker engine warm-up.

The degas bottle:

- provides a location for system fill.
- contains coolant expansion and system pressurization.
- provides air separation during operation.
- replenishes the engine coolant to the system.

The fan blade draws air through the radiator to help cool the engine coolant.

The fan motor:

- operates only when the engine is running.

The engine coolant flows:

- from the lower radiator hose to the water pump.
- from the water pump to the engine block and the cylinder heads.

A closed water thermostat returns the engine coolant to the water pump. An open water thermostat allows the engine coolant to flow to the radiator.

Engine coolant provides freeze protection, boil protection, cooling efficiency and corrosion protection to the engine and cooling components. In order to obtain these protections, the engine coolant must be maintained at the correct concentration and fluid level in the degas bottle.

When adding engine coolant, use a 50/50 mixture of engine coolant and clean, drinkable water.

To maintain the integrity of the cooling system:

- Add Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5-A, in Canada CXC-10) or equivalent meeting Ford specification ESE-M97B44-A (green coolant), or Motorcraft Premium Gold Engine Coolant VC-7-A or equivalent meeting Ford specification WSS-97B51-A1 (yellow color). Do not mix coolant types.
- Do not add/mix orange-colored Motorcraft Speciality Orange Engine Coolant, VC-2 or equivalent meeting Ford specification WSS-M97B44-D. Mixing coolants may degrade the coolant's corrosion protection.
- Do not add alcohol, methanol, brine or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.
- Do not mix with recycled coolant unless it meets the requirements of Ford specification ESE-M97B44-A or WSS-M97B51-A1. Not all coolant recycling processes meet these Ford specifications. Use of such coolants may harm the engine and cooling system components. Do not mix coolant types.

The cylinder head temperature sensor provides a signal to the temperature gauge and will invoke fail-safe cooling.

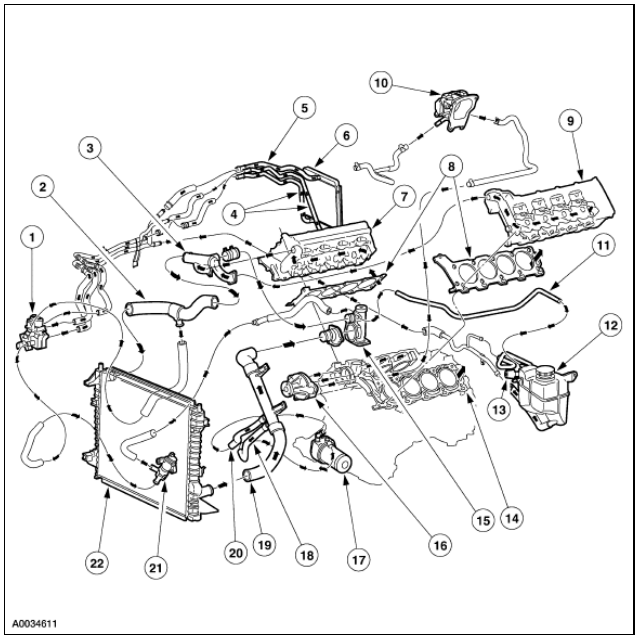
The optional block heater:

- electrical heating element is installed in the block cooling jacket.
    - ♦ uses a standard 110V (220V in Europe) electrical supply
- keeps the engine coolant warm during cold weather.

The auxiliary water pump (3.9L only):

- provides heater coolant flow boost.
- has a secondary function of providing engine-off cooling.

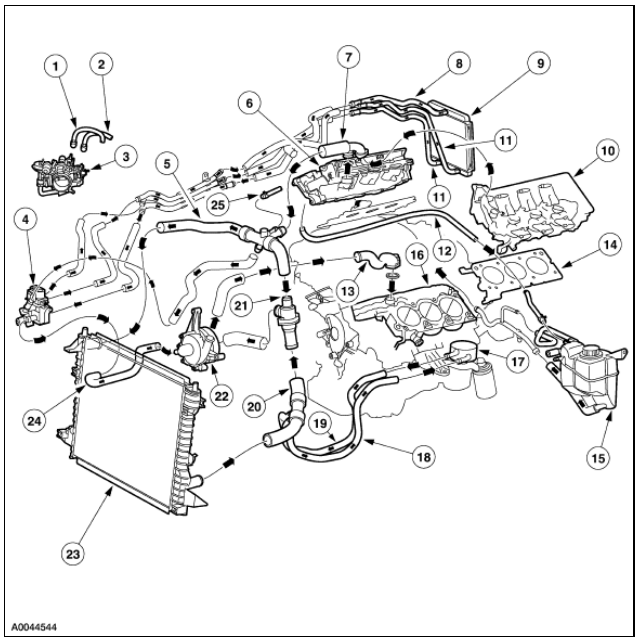
Coolant Flow 3.9L



Item	Part Number	Description

1		Coolant control valve
2	8260	Upper radiator hose
3	8A520	Coolant outlet tube
4	18472	Heater inlet hoses (2 req)
5	18472	Heater outlet hose
6	18476	Heater core
7	6049	Cylinder head RH
8		Cylinder head gasket (2 req)
9	6050	Cylinder head LH
10		Throttle body adapter
11		Engine vent hose
12		Degas bottle
13		Relief valve
14	6015	Cylinder block
15	8A587	Thermostat housing
16	8501	Water pump
17	6A642	Oil cooler
18		Oil cooler inlet hose
19	8286	Lower radiator hose
20		Oil cooler outlet hose
21		Auxiliary coolant pump
22	8005	Radiator

Coolant Flow 3.0L



Item	Part Number	Description
1		From degas vent
2		From upper radiator inlet
3	9E926	Throttle body
4		Coolant control valve

5		Upper radiator hose
6	6051	Cylinder head RH
7	8555	Coolant outlet tube
8	18472	Heater outlet hose
9	18476	Heater core
10	6049	Cylinder head LH
11	18472	Heater inlet hoses (2 req)
12		Engine vent hose (to throttle body)
13		Coolant outlet tube
14		Cylinder head gasket (2 req)
15		Degas bottle
16	6015	Cylinder block
17	6A642	Oil cooler
18		Oil cooler inlet hose
19		Oil cooler outlet hose
20		Lower radiator hose
21	8A857	Thermostat housing
22	8501	Water pump
23	8005	Radiator
24		Water pump inlet hose
25		To throttle body
26		Vent hose (to throttle body)

Engine Cooling

Special Tool(s)

 ST1474-A	Radiator Pressure Tester 014-R1072 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR Tester (NGS) 418-F052 (007-00520) or equivalent
 ST1477-A	Power Steering Analyzer 014-00207 (D79L-33610-A)
 ST1396-A	Dial Thermometer 0-220°F 023-R0007
 ST1720-A	Battery/Antifreeze Tester 014-R1060 or equivalent

Inspection and Verification

⚠ WARNING: To avoid personal injury, do not unscrew the coolant pressure relief cap while the engine is operating or hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly.

⚠ CAUTION: Check the coolant level, engine oil and transmission fluid, top off the coolant if needed. If there is engine coolant in the engine oil or transmission fluid, the cause must be corrected and oil/fluid changed or major component damage may occur.

⚠ CAUTION: Some vehicle cooling systems are filled with Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10 or equivalent) meeting Ford specification ESE-M97B44-A (green color). Others are filled with Motorcraft Premium Gold Engine Coolant VC-7-A meeting Ford specification WSS-M97B51-A1 (yellow color). Do not mix coolant types.

1. Verify the customer concern by operating the engine to duplicate the condition.

2. Inspect to determine if any of the following mechanical or electrical concerns apply.

Visual Inspection Chart

Mechanical	Electrical

• Leaks • Restricted airflow through the condenser/radiator • Damaged hoses • Loose/damaged hose clamps • Damaged water gasket • Damaged head gaskets • Damaged water pump • Damaged radiator • Damaged degas bottle • Damaged heater core • Hydraulic cooling fan system ♦ Fluid level ♦ Hydraulic line or joint leaks ♦ Kinked hydraulic lines	• Damaged cylinder head temperature sensor • Damaged wiring • Hydraulic cooling fan pump solenoid/solenoid wiring

⚠ CAUTION: The cylinder head temperature sensor is not reusable after removal on 3.9L engines. For electrical concern testing refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

3. If the inspection reveals an obvious concern that can be readily identified, repair it as necessary.

4. Inspect the coolant condition:

Inspect the coolant color.

- If Motorcraft Premium Engine Coolant (green-color) VC-4-A or equivalent meeting Ford specification ESE-M97B44-A has a clear, light green or blue color, this indicates higher water content than required.
- If Motorcraft Premium Gold Engine Coolant (yellow-color) VC-7-A or equivalent meeting Ford specification WSS-M97B51-A1 has a clear or pale yellow color, this indicates higher water content than required.
- Dark brown could indicate unauthorized stop leak may have been used. Use Motorcraft System Stop Leak Powder, part number E6AZ-19558-A (and RA-2) or equivalent meeting Ford specification ESE-M99B170-A except as noted in ES-F6SE-19A511-AA.
- A light or reddish brown color indicates that rust may be present in the cooling system. Flush the system and refill with the correct mixture of water and Premium Engine Coolant or Premium Engine Gold Coolant.
- An iridescent sheen on the surface of the coolant could indicate a trace of oil is entering the system. For additional information on engine diagnosis, refer to Section 303-00 .
- A milky brown color may indicate that either engine oil or transmission fluid is entering the cooling system. If transmission fluid is suspected, the cause may be a leaky radiator. Pressure test the cooling system. Refer to component tests in this section.
- If engine oil is suspected, the cause of the leak may be internal to the engine. For additional information on engine diagnosis, refer to Section 303-00 .
- If transmission fluid is contaminated with engine coolant, the cause may be a leaky radiator, pressure test the system. Refer to component tests in this section.

If the engine coolant appearance is acceptable, test the engine coolant freezing point range with the Battery/Antifreeze tester. The freezing point should be in the range -50°F to -10°F. If the vehicle is driven in cold climates less than -34°F, it may be necessary to increase the coolant concentration to get adequate freeze protection.

Maximum coolant concentration is 60/40.

Minimum coolant concentration is 40/60.

Adjust coolant range and level if necessary:

- If the coolant is low, add specified coolant mixture only.
- If the coolant tests weak, add straight engine coolant until the readings are within acceptable levels.
- If the coolant tests strong, remove some of the engine coolant and add water until the readings are within acceptable levels.

5. If the concern remains after the inspection, determine the symptom(s). GO to Symptom Chart .

6. Verify the cooling system is correctly filled and bled. Refer to Cooling System Draining, Filling And Bleeding in this section.

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: LOSS OF COOLANT

PINPOINT TEST B: THE ENGINE OVERHEATS

PINPOINT TEST C: THE ENGINE DOES NOT REACH NORMAL OPERATING TEMPERATURE

Component Tests

Pressure Test

1. Turn the engine OFF.

2. Remove the cowl vent screen. Refer to Section 501-02 .

3. ⚠ **WARNING: Never remove the pressure relief cap under any conditions while the engine is operating. Failure to follow these instructions can result in damage to the cooling system or engine and/or personal injury. To avoid having scalding hot coolant or steam blow out of the cooling system, never remove the pressure relief cap from a hot degas bottle. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is released from the cooling system. When certain all the pressure has been released, remove the pressure relief cap (still with a cloth).**

   Check the engine coolant level. Refer to Cooling System Draining, Filling And Bleeding in this section.

4. Connect the Radiator/Heater Core Pressure Tester to the degas bottle nipple and overflow hose. Install a pressure test pump to the quick-connect fitting of the test adapter.

5. **NOTE:** If the plunger of the pump is depressed too fast, an erroneous pressure reading will result.

   Slowly depress the plunger of the pressure test pump until the pressure gauge reading stops increasing and note the highest pressure reading obtained.

6. If the pressure relief cap does not hold pressure, remove and wash the pressure relief cap in clean water to dislodge all foreign particles from the gaskets. Check the sealing surface in the filler neck.

7. If 8-9 kPa (13 psi) cannot be reached, install a new pressure relief cap. If more than 12 kPa (18 psi) shows on the gauge, install a new pressure relief cap.

8. ⚠ **CAUTION: If the pressure drops, check for leaks at the engine to heater core hoses, engine-to-radiator hoses, water valve hose (if applicable), oil cooler return tube gasket, radiator and heater core or other system components and connections. Any leaks which are found must be corrected and the system rechecked.**

   Pressurize the engine cooling system as described in Step 4 (using a pressure relief cap that operates within the specified upper and lower pressure limits). Observe the gauge reading for approximately two minutes; refer to General Specifications. Pressure should not drop during this time.

9. Release the system pressure by loosening the pressure relief cap. Check the engine coolant level and replenish, if necessary, with the correct engine coolant mixture. Refer to Cooling System Draining, Filling And Bleeding in this section.

Cap

⚠ **WARNING: Never remove the pressure relief cap under any conditions while the engine is operating. Failure to follow these instructions can result in damage to the cooling system or engine and/or personal injury. To avoid having scalding hot coolant or steam blow out of the cooling system, use extreme care when removing the pressure relief cap from a hot degas bottle. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is released from the cooling system. When certain all the pressure has been released, remove pressure relief cap (still with a cloth).**

1. Remove the pressure relief cap from the degas bottle.

2. Immerse the pressure relief cap in water and install it on the shallow filler neck of Radiator/Heater Core Pressure Tester and Radiator Cap Adapter, part of the Radiator/Heater Core Pressure Tester.

3. Immerse the filler neck seal in water and install it in the filler neck adapter.

4. Install the filler neck adapter with the filler neck seal to the Radiator Cap Adapter.

5. Connect the female quick-connect fitting of the pressure test pump to the male quick-connect fitting of the filler neck adapter.

6. **NOTE:** If the plunger of the pump is depressed too fast, an erroneous pressure reading will result.

   Slowly depress the plunger of the pressure test pump until the pressure gauge reading stops increasing and note the highest pressure reading obtained.

7. Release the pressure by turning the relief screw counterclockwise. Then tighten the pressure relief screw and repeat Step 6 (at least twice) to make sure the reading is repeatable within the

specifications of the pressure relief cap.

8. If the pressure test gauge readings are not within specifications, install a new pressure relief cap. If the pressure test gauge readings are within specifications, carry out the cooling system Pressure Test.

Thermostat Water

A new water thermostat should be installed only after the following electrical and mechanical tests have been carried out.

Thermostat Electrical Test

NOTE: The electrical thermostat test is most accurate if carried out indoors at less than 37.8°C (100°F) ambient air. This test may be carried out with or without the hood open and with the engine warm or cold.

1. Check the engine coolant level. Fill as needed.

2. With the ignition OFF, attach the Rotunda 73 Digital Multimeter. It may be used to monitor sensor voltage values between 0-5 volts.

3. **NOTE:** Running this test with the vehicle in gear or with the A/C compressor clutch engaged (running) will cause incorrect diagnosis.

   Place the transmission in PARK (P) or NEUTRAL (N).

4. Start the engine and allow the engine to idle throughout this test. Allow the engine to run for two minutes, then record the CHT voltage. Record the CHT voltage every 60 seconds. When the CHT voltage trend changes direction or only changes slightly (0.03 volt or less) from the previous reading, record this as the thermostat opening voltage. Use the voltage and corresponding coolant temperature chart listed below.

Coolant Temp °C (°F)	CHT Min (Volts)	CHT Nom (Volts)	CHT Max (Volts)
0 (32)	4.7714	4.8032	4.8723
25 (77)	4.3428	4.4148	4.4727
50 (122)	3.5354	3.6495	3.7473
80 (176)	2.3049	2.4201	2.5260
110 (230)	1.3021	1.3808	1.4562
140 (284)	0.6960	0.7414	0.7857
170 (338)	0.3784	0.4024	0.4261

5. If the thermostat opening voltage is less than 2.3049 volts and less than 80°C (176°F), install a new water thermostat.

6. If the thermostat opening voltage is greater than 2.3049 volts 82°C (180°F), the water thermostat is good and a new water thermostat should not be installed. GO to Symptom Chart .

Thermostat Mechanical Test

1. Remove the water thermostat.

2. Check the water thermostat for seating. Hold the water thermostat up to a lighted background. Leakage of light around the thermostat valve at room temperature indicates a new water thermostat should be installed. Some water thermostats have a small leakage notch at one location on the perimeter of the thermostat valve, which is considered normal.

3. Immerse the water thermostat in a boiling antifreeze and water mixture.

4. See the General Specifications chart for water thermostat opening temperatures.

Radiator Leak Test, Removed From the Vehicle

⚠ CAUTION: Never leak test an aluminum radiator in the same water that copper/brass radiators are tested in. Flux and caustic cleaners may be present in the cleaning tank and they will damage aluminum radiators.

NOTE: Always install plugs in the oil cooler fittings before leak testing or cleaning any radiator.

NOTE: Clean the radiator before leak testing to avoid contamination of tank.

1. Leak test the radiator in clean water with 138 kPa (20 psi) air pressure.

Hydraulic Cooling Fan Reservoir

1. Reduce the fluid in the reservoir by half.

2. Attach the scan tool to the vehicle.

3. Start the engine and command MAX fan.

4. Maintain 2,500 rpm. Fluid should be observed through the reservoir returning. The internal return also functions as a relief valve; fluid must be observed through the sides of the return. If the fluid is not returning through the sides, the screen is plugged. If no or little return is observed or the fluid is returning through the pressure relief, install a new reservoir.

Hydraulic Cooling Fan Motor

1. Inspect the fan blade and shroud for any foreign materials. Clear the obstruction and continue the test procedure.

2. Rotate the fan to see if any contact between the shroud and blade exists. If contact is observed, install a new fan shroud assembly.

3. Rotate the fan by hand. The fan should rotate freely (no resistance should be felt, the fan will free wheel with minimum effort). If any resistance is present, install a new fan assembly.

4. Attempt to move the fan blade and shaft in and out and side to side. If any movement is detected install a new fan assembly.

Hydraulic Cooling Fan Pump

⚠ WARNING: Do not touch the flowmeter during the test procedure or severe burns and serious injury may occur.

1. **⚠ CAUTION: Make sure that the connection point will not interfere with any of the engine accessory drive components or drive belts.**

   NOTE: On some vehicles the port may not be easily accessible. The power steering analyzer should then be hooked up at the hydraulic cooling fan motor or at a point in the high pressure line between the motor and the hydraulic cooling fan pump.

   Install the power steering analyzer at the high pressure port of the hydraulic cooling fan pump. Make sure the power steering analyzer gate is fully open.

2. **⚠ CAUTION: A noisy fan system must be bled and refilled before proceeding with any of the test procedures. Refer to Hydraulic Cooling Fan System Filling and Bleeding in this section.**

   Check the cooling fan hydraulic fluid level. If necessary, add fluid.

   - Use MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX meeting Ford specification MERCON® or equivalent.

3. Remove the reservoir screen and place the dial thermometer in the hydraulic cooling fan reservoir.

4. Start the engine and allow the engine to warm up until the fan turns on.

5. Allow fluid temperature to reach 74-80°C (165-175°F).

6. Record the flow rate and pressure readings.

7. **NOTE:** The pressure relief valve will open at 1,050 ± 100 psi (7,240 kPa ± 689.5 kPa). If the pressure is above 1,200 psi (8,275 kPa), a new pump pressure relief valve must be installed.

   Turn the A/C on MAX, and record the flow and pressure readings. The flow and pressure readings should increase.

   - If the flow and pressure readings do not increase, install a new hydraulic cooling fan pump.

8. Partially close the gate valve to achieve 300 psi (2,068.5 kPa). The flow rate should be 1.65 ±.25 gpm.
   - If the flow rate is less than specified, install a new hydraulic cooling fan pump.

Cooling System Draining, Filling And Bleeding

Draining

⚠ WARNING: Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, (still with a cloth) turn and remove the pressure relief cap.

⚠ CAUTION: The coolant must be recovered in a suitable, clean container for reuse. If the coolant is contaminated it must be recycled or disposed of correctly.

⚠ CAUTION: Care must be taken to ensure the accessory drive belt does not become contaminated with engine coolant.

⚠ CAUTION: Some vehicle cooling systems are filled with Motorcraft Premium Engine Coolant VC-4-A (in Oregon VC-5, in Canada CXC-10) or equivalent meeting Ford specifications ESE-M97B44-A (green color). Others are filled with Motorcraft Premium Gold Engine Coolant VC-7-A or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Always refill the cooling system with the same coolant that was drained from the system. Do not mix coolant types.

1. Release the pressure in the cooling system by slowly turning the pressure relief cap one half turn counterclockwise. When the pressure is released, remove the pressure relief cap.

2. **NOTE:** Less than 80% of coolant can be recovered with the engine in the vehicle. Dirty, rusty or contaminated coolant requires replacement.

   Place a suitable container below the radiator draincock. If equipped, disconnect the coolant return hose at the oil cooler.

   - Close the radiator draincock when finished.

Filling Bleeding

⚠ CAUTION: Engine coolant provides freeze protection, boil protection, cooling efficiency and corrosion protection to the engine and cooling components. In order to obtain these protections, the engine coolant must be maintained at the correct concentration and fluid level in the degas bottle.

When adding engine coolant, use a 50/50 mixture of engine coolant and clean, drinkable water.

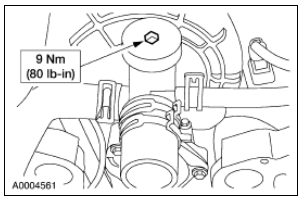
To maintain the integrity of the coolant and the cooling system:

- Add Motorcraft Premium Engine Coolant VC-4-A (VC-5 in Oregon, CXC-10 in Canada) or equivalent meeting Ford specification ESE-M97B44-A (green color), or Motorcraft Premium Gold Engine Coolant VC-7-A or equivalent meeting Ford specification WSS-M97B51-A1 (yellow color). Use the same coolant that was drained from the cooling system. Do not mix coolant types.

- Do not add orange-colored Motorcraft Speciality Orange Engine Coolant VC-2 meeting Ford specification WSS-M97B44-D. Mixing coolants may degrade the coolant's corrosion protection.
- Do not add alcohol, methanol, brine or any engine coolants mixed with alcohol or methanol antifreeze. These can cause engine damage from overheating or freezing.
- Do not mix recycled coolant unless it meets the requirements of Ford specification ESE-M97B44-A or WSS-M97B51-A1. Not all coolant recycling processes meet these Ford specifications. Use of such a coolant may harm the engine and cooling system components.

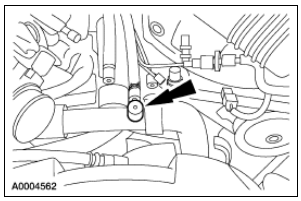
On 3.9L engines

1. Remove the engine fill cap.



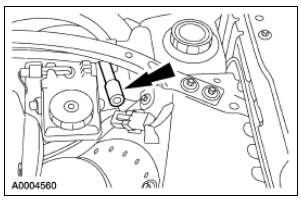
On 3.0L engines

2. Open the engine air bleed.



On all engines

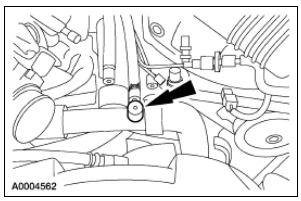
3. Open the heater air bleed.



4. Add coolant to the degas bottle allowing the system to equalize until no more coolant can be added.

On 3.0L engines

5. Close the engine air bleed when coolant begins to escape.



On all engines

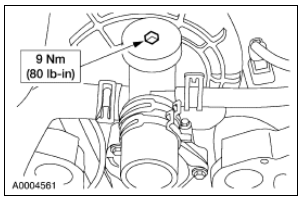
6. Replace the degas bottle cap.

On 3.9L engines

⚠ CAUTION: Care must be taken to ensure the accessory drive belt does not become contaminated with engine coolant.

7. Add as much coolant as possible to the engine fill. The heater air bleed will remain open.

8. Replace the engine fill cap.

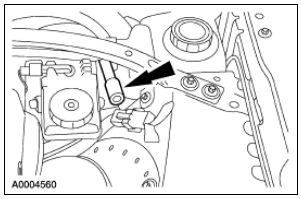


On all engines

9. **NOTE:** The heater air bleed remains open.

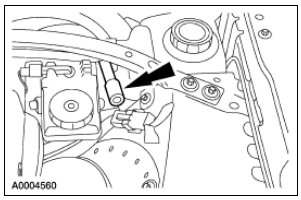
   Start the engine and turn the heater to MAX position.

10. Close the heater air bleed when a steady stream of coolant comes from it, during engine idle.



11. Allow the engine to idle for five minutes, add coolant to the degas bottle as needed to maintain the cold fill MAX mark.

12. Reopen the heater air bleed to release any entrapped air and close again.



On 3.9L engines

13. Maintain engine speed of 2,000 rpm for 3-5 minutes or until hot air comes from the heater.

14. Return to idle and verify hot air is still coming from the heater.

On 3.0L engines

15. Maintain engine speed of 1,500 rpm for 3-5 minutes or until hot air comes from the heater.

16. Return to idle and verify hot air is still coming from the heater.

On all engines

17. Set the heater temperature setting to 24°C (75°F) and allow the vehicle to idle for two minutes.
18. Shut the engine off and allow to cool.
19. After the engine has cooled, add coolant to the degas bottle to bring the level to the cold fill MAX mark.

Hydraulic Cooling Fan System Filling and Bleeding

Special Tool(s)

 ST1176-A	Vacuum Tester 014-R1054 or equivalent

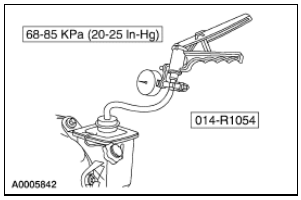
Material

Item	Specification
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX or equivalent	MERCON®

NOTE: It is not uncommon to repeat this procedure three times.

1. Fill the hydraulic cooling fan reservoir to the MAX level.
   - Use Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid.

2. Apply vacuum for two to three minutes.
   - Remove the vacuum pump.



3. Start the engine and turn the A/C on MAX. This will run the hydraulic fan. If a whining noise is heard, repeat the procedure.

Engine and Radiator Flushing

Special Tool(s)

 ST1168-A	Flush Kit 164-R3658 or equivalent
 ST1167-A	Drain Kit 164-R3662 or equivalent
 ST2421-A	Pro Flush and Fill, Coolant 023-00154 or equivalent

Material

Item	Specification
Premium Cooling System Flush VC-1	ESR-M14P7-A

1. ⚠ **WARNING: Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, (still with a cloth) turn and remove the pressure relief cap.**

   Once pressure is released, remove the pressure relief cap.

2. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding .

3. Remove the water thermostat. For additional information, refer to Thermostat Housing - 3.0L , or Thermostat - 3.9L in this section.

4. Install the water hose connection without the water thermostat.

5. **NOTE:** Refer to the cooling system Pro Flush and Fill operating instructions for specific vehicle hook-up.

   Use cooling system Pro Flush and Fill, Coolant Flush Kit and Drain Kit to flush the engine and radiator.

6. Install the water thermostat.

7. Backflush the heater core. For additional information, refer to Heater Core Backflushing .

8. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

Heater Core Backflushing

Special Tool(s)

 ST1168-A	Flush Kit 164-R3658 or equivalent
 ST1167-A	Drain Kit 164-R3662 or equivalent
 ST2421-A	Pro Flush and Fill, Coolant 023-00154 or equivalent

Material

Item	Specification
Premium Cooling System Flush VC-1	ESR-M14P7-A

1. ⚠ **WARNING: Never remove the pressure relief cap while the engine is operating or when the cooling system is hot. Failure to follow these instructions can result in damage to the cooling system or engine or personal injury. To avoid having scalding hot coolant or steam blow out of the degas bottle when removing the pressure relief cap, wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, (still with a cloth) turn and remove the pressure relief cap.**

   Once pressure is released, remove the pressure relief cap.

2. Partially drain the cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

3. **NOTE:** Refer to the cooling system Pro Flush and Fill operating instructions for particular vehicle hook-up.

   Use cooling system Pro Flush and Fill, Flush Kit and Drain Kit to backflush the heater core.

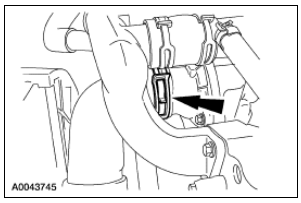
4. Fill the cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

Thermostat 3.9L

1. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .

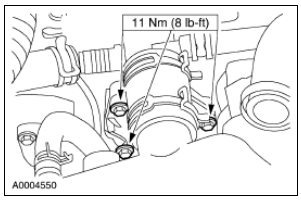
2. Drain the cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding .

3. Disconnect and position the lower radiator hose out of the way.

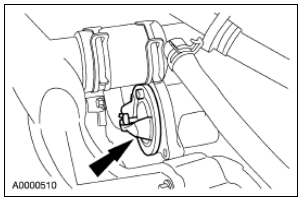


4. **NOTE:** Use care so that coolant does not get on the drive belt.

   Remove the bolts and the thermostat housing.



5. Remove the thermostat and the O-ring.



6. To install, reverse removal procedure. Clean all the sealing surfaces and install a new O-ring.

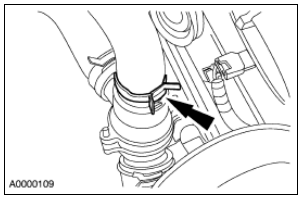
Thermostat Housing 3.0L

Removal

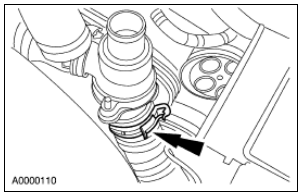
1. Drain the engine cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

2. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .

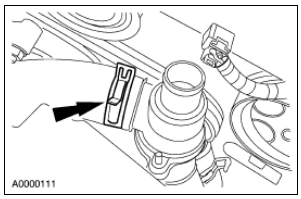
3. Disconnect the hose.



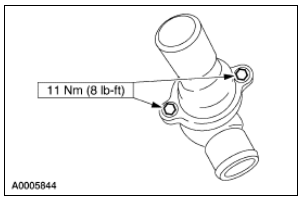
4. Disconnect the hose.



5. Disconnect the hose and remove the thermostat housing assembly.



6. Remove the bolts, separate the housing and remove the thermostat and seal.



Installation

1. **NOTE:** Clean all the sealing surfaces and inspect the O-ring seals thoroughly.

   To install, reverse the removal procedure.

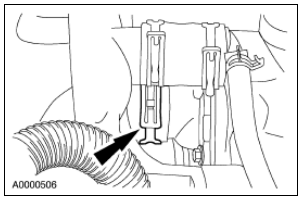
Thermostat Housing 3.9L

Removal

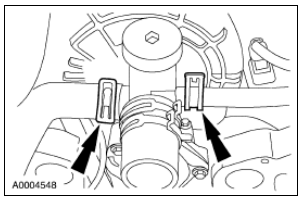
1. Drain the engine cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

2. Remove the intake manifold. For additional information, refer to Section 303-01B .

3. Disconnect the lower radiator hose from the thermostat housing and position out of the way.

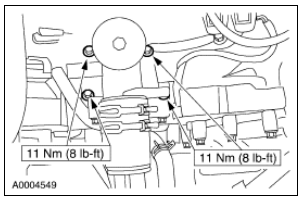


4. Disconnect the hoses.



5. Remove the coolant outlet pipe. For additional information, refer to Coolant Outlet Pipe 3.9L in this section.

6. Remove the four bolts and the thermostat housing.



Installation

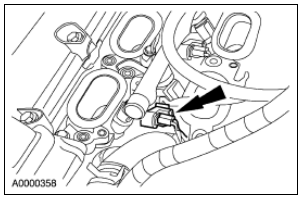
1. **NOTE:** Clean all the sealing surfaces, and install a new O-ring seal.

   To install, reverse the removal procedure.

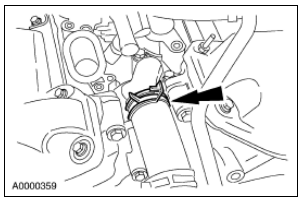
Coolant Outlet Pipe 3.0L

Removal

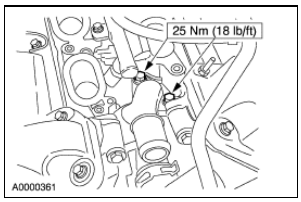
1. Remove the upper intake manifold. For additional information, refer to Section 303-01A .
2. Disconnect the fuel injector electrical connector.



3. Disconnect the hose.



4. Remove the bolts and the coolant outlet pipe.



Installation

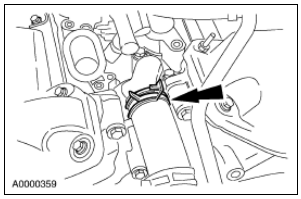
1. **NOTE:** Clean all the sealing surfaces and inspect the O-ring seals thoroughly.

   To install, reverse the removal procedure.

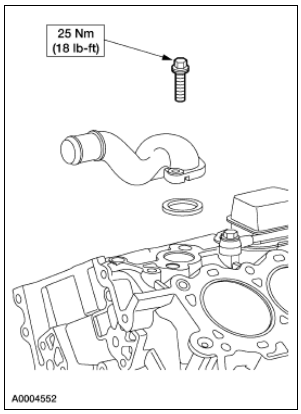
Coolant Inlet Pipe 3.0L

Removal

1. Remove the lower intake manifold. For additional information, refer to Section 303-01A .
2. Disconnect the hose.



3. Remove the bolts and the coolant inlet pipe.



Installation

1. **NOTE:** Clean all the sealing surfaces and inspect the O-ring seals thoroughly.

   To install, reverse the removal procedure.

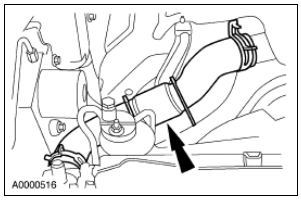
Coolant Outlet Pipe 3.9L

Removal

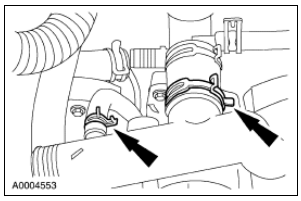
1. Drain the engine cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

2. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .

3. Remove the upper radiator hose.

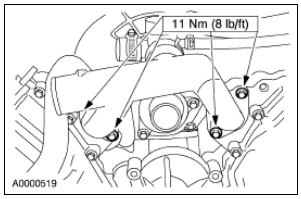


4. Disconnect the hoses.

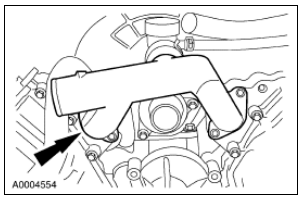


5. **NOTE:** Lower radiator hose not shown for illustration purposes.

   Remove the four bolts.

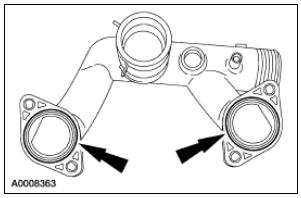


6. Remove the coolant outlet pipe.



7. **NOTE:** Lower radiator hose not shown for illustration purposes.

   Remove the O-ring seals, inspect and clean the sealing surfaces.



Installation

1. To install, reverse the removal procedure.

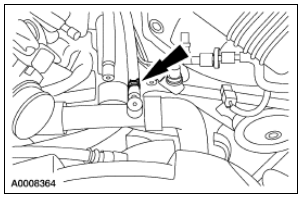
Water Pump 3.0L

Removal

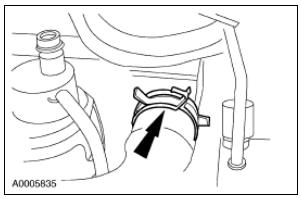
1. Drain the engine cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

2. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .

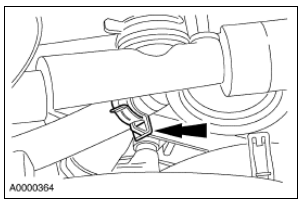
3. Disconnect the engine vent hose.



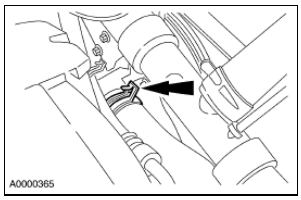
4. Disconnect the upper radiator hose.



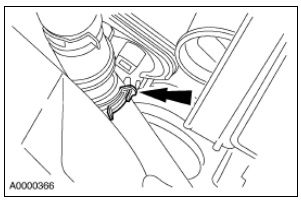
5. Disconnect the heater supply hose.



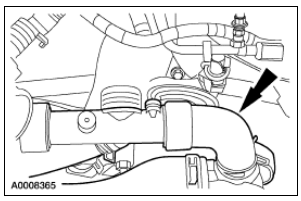
6. Disconnect the water pump hose.



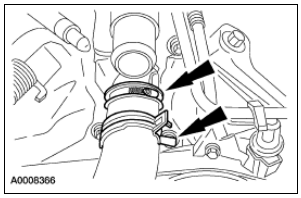
7. Disconnect the lower radiator hose from the thermostat housing.



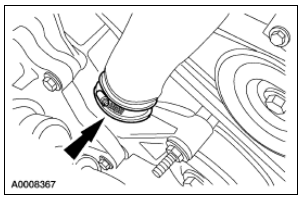
8. Remove the water crossover assembly.



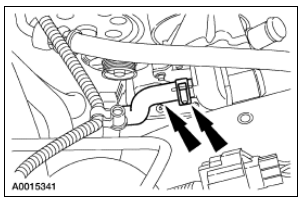
9. Disconnect the water inlet hose from the coolant outlet pipe.



10. Disconnect and remove the water inlet hose from the pump.

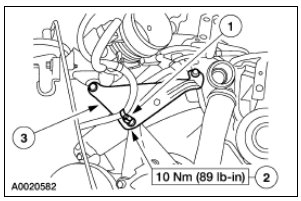


11. Disconnect the heater water hose from the water pump.

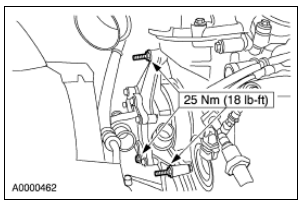


12. Remove the belt idler pulley. For additional information, refer to Section 303-05 .

13. Remove the bracket.
    1. Unclip the wiring harness.
    2. Remove the two studbolts and the bolt.
    3. Remove the bracket.



14. Remove the bolt and the studs. Remove the water pump assembly.



Installation

1. To install, reverse the removal procedure.

Water Pump 3.9L

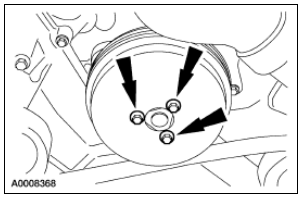
Material

Item	Specification
Motorcraft Premium Gold Engine Coolant VC-7-A or equivalent	WSS-M97B51-A1
Motorcraft Premium Engine Coolant VC-4-A or equivalent	ESE-M97B44-A

Removal

1. Drain the engine cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

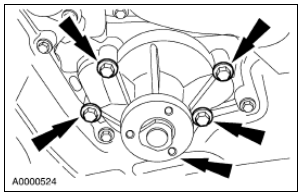
2. Loosen the water pump pulley bolts.



3. Remove the accessory drive belt. For additional information, refer to Section 303-05 .

4. Remove the water pump pulley bolts and the pulley.

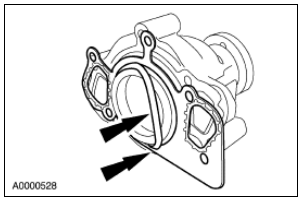
5. Remove the five bolts and the water pump.



6. **NOTE:** Clean and inspect the sealing surfaces.

   Remove the gasket and discard.

   - Inspect the O-ring seal. Install a new O-ring seal as necessary.
   - Visually inspect the rotors in the water pump.



Installation

1. **NOTE:** Lubricate the water pump O-ring using the appropriate coolant.

   Install a new gasket and the water pump, and tighten the bolts in two stages:

   - Stage 1: Tighten to 8 Nm (71 lb-in).
   - Stage 2: Tighten an additional 90 degrees.

2. Install and tighten the water pump pulley in two stages:
   - Stage 1: Tighten to 10 Nm (89 lb-in).
   - Stage 2: Tighten an additional 45 degrees.

3. Install the accessory drive belt. For additional information, refer to Section 303-05 .

4. Refill the engine cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

Cooling Fan Motor and Shroud

Special Tool(s)

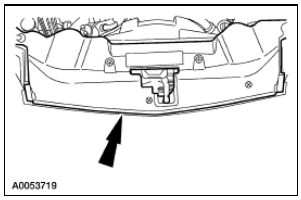
 ST1444-A	Teflon® Seal Replacer Set 211-D027 (D90P-3517-A) or equivalent

Removal and Installation

On all engines

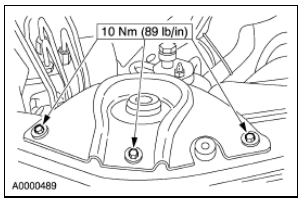
1. Drain the engine cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

2. Remove the upper radiator sight shield.



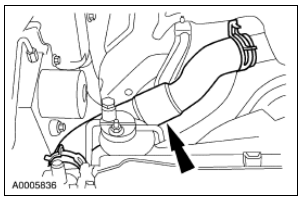
3. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .

4. Remove the six bolts and the two radiator upper support brackets.

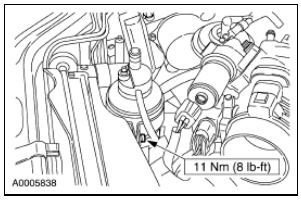


5. **NOTE:** 3.9L shown; 3.0L similar.

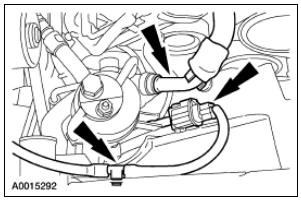
   Remove the upper radiator hose.



6. Remove the bolt and position the receiver drier aside.

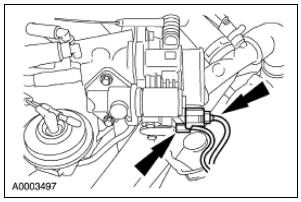


7. Disconnect the dual flow coolant valve electrical connector and the A/C line from the fan shroud.

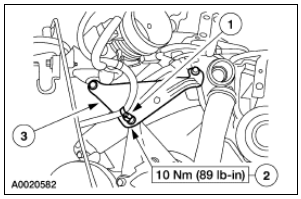


On 3.0L engines

8. Disconnect the throttle position (TP) sensor and the idle air control (IAC) valve electrical connectors.

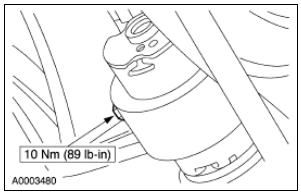


9. Remove the bracket.
    1. Remove the bolts.
    2. Remove the bracket.



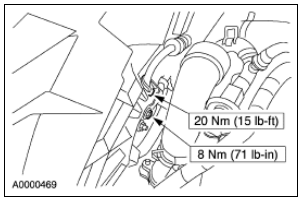
On 3.9L engines

10. Remove the bolt and position the electric water pump aside.

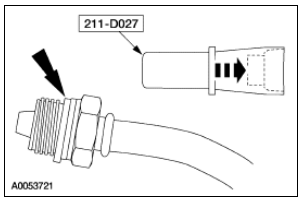


On all engines

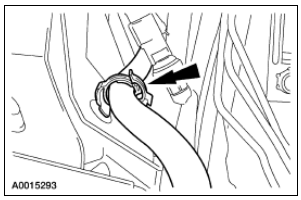
11. Disconnect the high pressure cooling fan bracket and line.



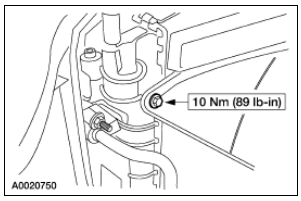
12. Using the appropriate special tool, install a new O-ring on the power steering pressure hose fitting.



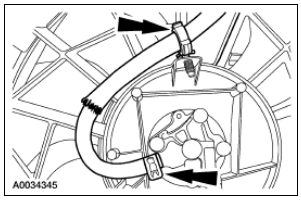
13. Separate the return hose from the fan shroud and position aside.



14. Remove the two bolts and position the fan shroud assembly.

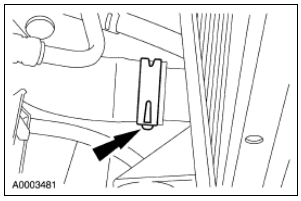


15. Disconnect the return hose from the cooling fan and shroud and remove the cooling fan and shroud assembly.

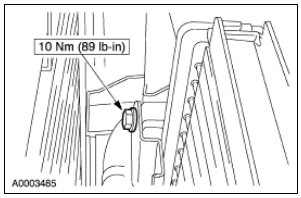


16. Remove the A/C condenser. For additional information, refer to Section 412-03 .

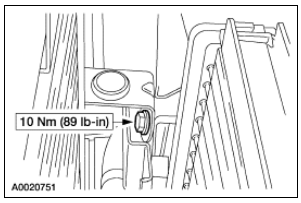
17. Disconnect the lower radiator hose.



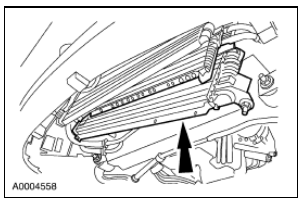
18. Remove the two bolts and position the multi-cooler assembly aside.



19. Remove the bolts and the condenser support brackets.



20. Remove the radiator.



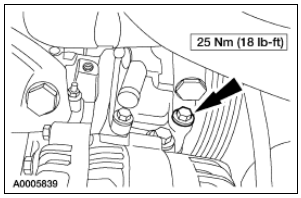
21. To install, reverse the removal procedure.

Fan Pump, 3.0L

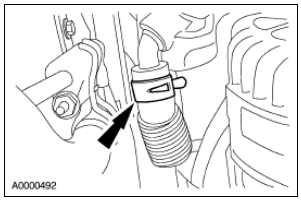
Removal and Installation

1. Remove the accessory drive belt. For additional information, refer to Section 303-05 .

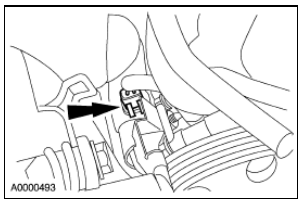
2. Remove the lower bolt.



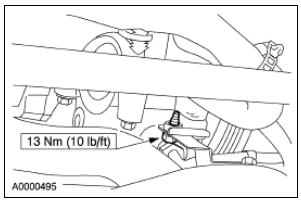
3. Disconnect the hose and allow to drain.



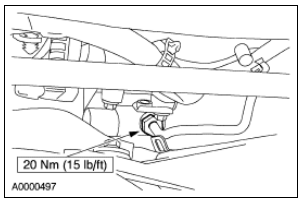
4. Disconnect the electrical connector.



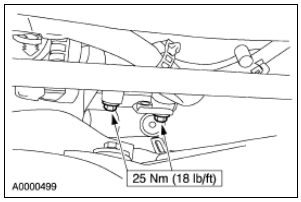
5. Remove the bolt and the high pressure line bracket.



6. Disconnect the high pressure line.



7. Remove the two upper bolts and the cooling fan pump.



8. To install, reverse the removal procedure.

Fan Pump, 3.9L

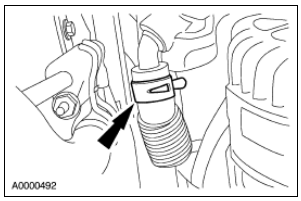
Special Tool(s)

 ST1444-A	Installer Set, Teflon® Seal 211-D027 (D90P-3517-A) or equivalent

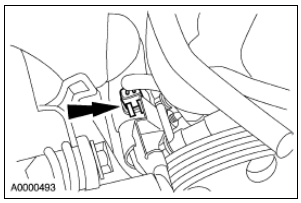
Removal and Installation

1. Remove the generator. For additional information, refer to Section 414-02 .

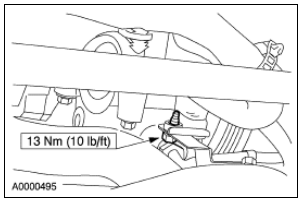
2. Disconnect the hose and allow to drain.



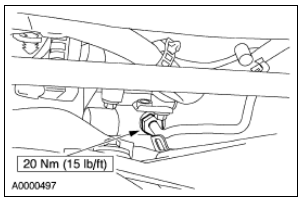
3. Disconnect the electrical connector.



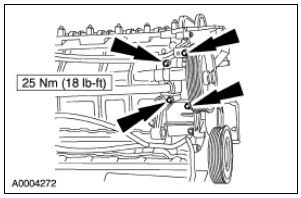
4. Remove the bolt and the high pressure line bracket.



5. Disconnect the high pressure line.

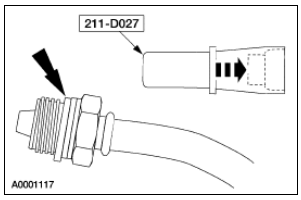


6. Remove the bolts and the cooling fan pump.



7. To install, reverse the removal procedure.

8. Using the appropriate special tool, install a new O-ring on the hydraulic cooling fan pressure hose fitting.



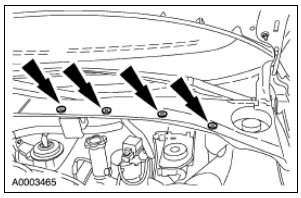
9. Fill and bleed the hydraulic cooling fan system. For additional information, refer to Section 303-03 .

Degas Bottle

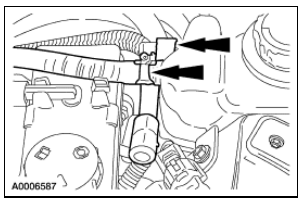
Removal and Installation

1. Drain the engine cooling system. For additional information, refer to Cooling System Draining, Filling And Bleeding in this section.

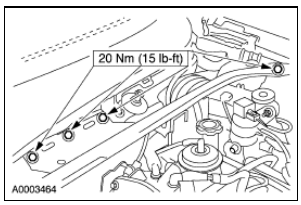
2. Remove the cowl vent screen. For additional information, refer to Section 501-02 .



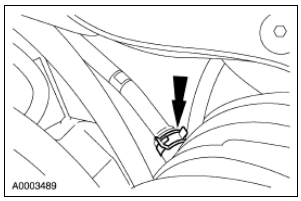
3. Disconnect the engine vent hose, and separate the air bleed hose from the degas bottle.



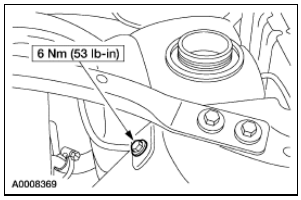
4. Remove the seven bolts and reposition the cross vehicle support.



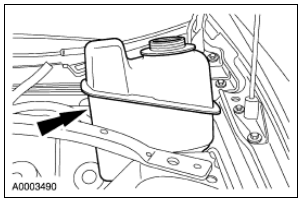
5. Disconnect the degas return hose from the degas return tube.



6. Remove the two bolts.



7. Remove the degas bottle from the vehicle.



8. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Fuel pressure relief valve	7		62
Throttle body bolts	10		89

Fuel Charging And Controls

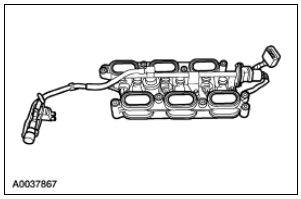
The fuel charging and controls system consists of the:

- throttle body
- fuel injectors
- fuel charging wiring
- fuel supply manifold
- fuel pressure relief (Schrader) valve

The fuel charging and controls system is:

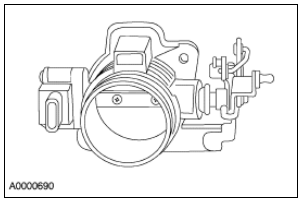
- a sequential multiport fuel injection (SFI) system.
- pulse width modulated.
- mass airflow-controlled.

The powertrain control module (PCM) controls the fuel injection system. Injector pulse-width is varied to control the amount of fuel flow. Varying fuel pump output controls fuel pressure. The PCM commands the fuel pump driver module, which directly controls the fuel pump. At low speeds, the idle air control (IAC) valve controls the bypass air around the throttle plate.



The fuel supply manifold:

- delivers fuel to the individual fuel injectors.
- receives fuel from the fuel supply line.
- is serviced as a lower intake manifold assembly only. For additional information, refer to Section 303-01A .



The throttle body:

- controls air supply to the upper intake manifold by positioning the throttle plate.
- connects the accelerator cable and the speed control actuator cable to the throttle plate.
- is not adjustable.
- must not be cleaned.
- has a different linkage ratio depending on the type of transmission (automatic or manual).

The fuel pressure relief valve:

- is used as a test port and to relieve fuel pressure.

Fuel Charging And Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Throttle Body

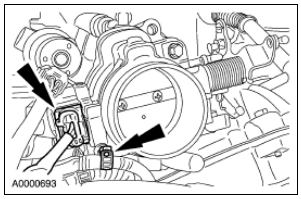
Removal and Installation

⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

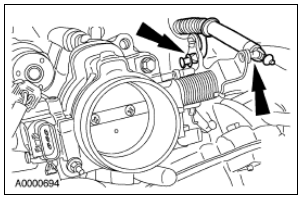
⚠ CAUTION: The throttle body bore and plate area have a special coating and cannot be cleaned.

1. Remove the air cleaner outlet tube from the throttle body. For additional information, refer to Section 303-12 .

2. Disconnect the throttle position sensor electrical connector and the wiring harness retainer.

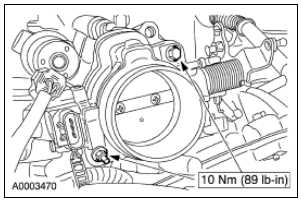


3. Disconnect the accelerator cable and the speed control actuator cable from the throttle body.



4. **NOTE:** The throttle body (TB) gasket is reusable.

   Remove the bolts and the throttle body.



5. To install, reverse the removal procedure.

Fuel Pressure Relief Valve

Removal and Installation

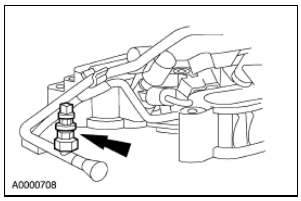
⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

⚠ WARNING: Fuel in the system remains under high pressure even when the engine is not running. Use care when working on the fuel system or personal injury may occur.

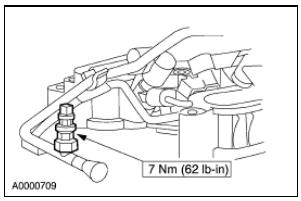
⚠ WARNING: Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent possible personal injury.

1. Relieve the fuel system pressure. For additional information, refer to Section 310-00 .

2. Remove the fuel pressure relief valve cap and the fuel pressure relief valve.



3. To install, reverse the removal procedure.



General Specifications

Item	Specification
Super Premium SAE 5W-20 Motor Oil XO-5W20-QSP (in Canada CXO-5W20-LSP12) or equivalent	WSS-M2C153-H

Torque Specifications

Description	Nm	lb-ft	lb-in
Engine appearance cover bracket nuts	6		53
Fuel injection supply manifold bolts	13	10	
Throttle body bolts	12	9	

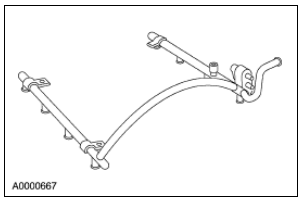
Fuel Charging And Controls

The fuel charging and controls system consists of the:

- throttle body (9E926)
- fuel injectors (9F593)
- engine wiring harness (12B637)
- fuel injection supply manifold (9F792)
- fuel pressure relief valve (9H321)

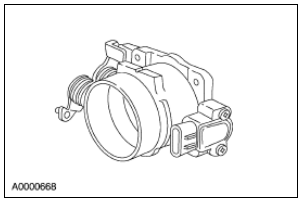
The fuel charging and controls system is:

- a sequential multiport fuel injection (SFI) system.
- pulse width modulated.
- mass airflow controlled.



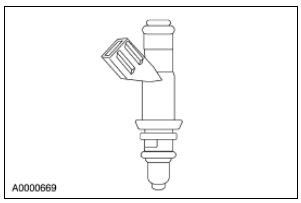
The fuel injection supply manifold:

- delivers fuel to the individual fuel injectors.
- receives fuel from the fuel supply line.



The throttle body:

- controls air supply to the intake manifold (9C633) by positioning the throttle plate.
- connects the accelerator cable (9A758) and the speed control actuator cable (9A825) to the throttle plate.
- is not adjustable.
- must not be cleaned.



The fuel injectors:

- are electrically operated by the powertrain control module (PCM) (12A650).

- have an air assist feature to aid in atomization of the fuel.
- each have an internal solenoid which opens a needle valve to inject fuel into the lower intake manifold.
- atomize the fuel as the fuel is delivered.
- are deposit-resistant.
- do not need cleaning.

The fuel pressure relief valve:

- is used to relieve fuel pressure.

The engine wiring harness:

- connects the fuel injectors and other electronic engine controls, such as the throttle position (TP) sensor (9B989), to the powertrain control module.
- receives fuel injector signals from the powertrain control module and transfers the signals to the fuel injectors.

Fuel Charging And Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Throttle Body

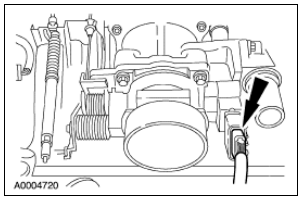
Removal

⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

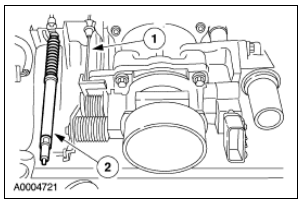
⚠ CAUTION: Throttle body bore and plate area have a special coating and cannot be cleaned.

1. Remove the air cleaner outlet tube from the throttle body. For additional information, refer to Section 303-12 .

2. Disconnect the throttle position (TP) sensor electrical connector.



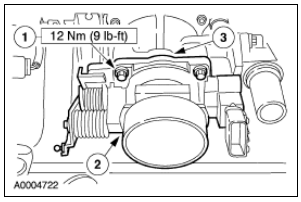
3. Disconnect the throttle body linkages.
    1. Disconnect the speed control actuator cable.
    2. Disconnect the accelerator cable.



4. **NOTE:** Discard the throttle body (TB) gasket.

   Remove the throttle body.

    1. Remove the four bolts.
    2. Remove the throttle body.
    3. Remove the throttle body gasket.



Installation

1. **NOTE:** Use a new throttle body gasket.

   To install, reverse the removal procedure.

Fuel Injectors

Material

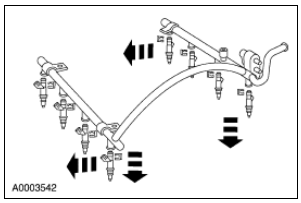
Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP (in Canada CXO-5W20-LSP12) or equivalent	WSS-M2C153-H

Removal

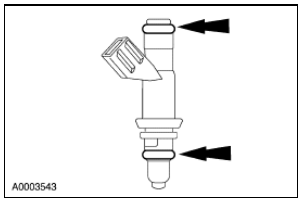
⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

1. Remove the fuel injection supply manifold. For additional information, refer to Fuel Injection Supply Manifold in this section.

2. Remove the retaining clip and the fuel injectors from the fuel injection supply manifold.



3. Remove and discard the two O-ring seals from each fuel injector.



Installation

1. **⚠ CAUTION: Install new O-ring seals.**

   NOTE: Lubricate new fuel injector O-ring seals with clean engine oil.

   To install, reverse the removal procedure.

Fuel Injection Supply Manifold

Material

Item	Specification
Super Premium SAE 5W-20 XO-5W20-DSP (in Canada CXO-5W20-LSP12) or equivalent	WSS-M2C153-H

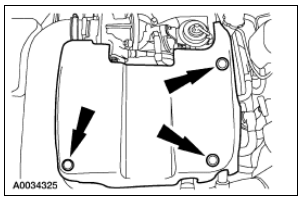
Removal

⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

⚠ WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Use care when working on the fuel system or personal injury may occur.

⚠ WARNING: Before working on or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent possible personal injury.

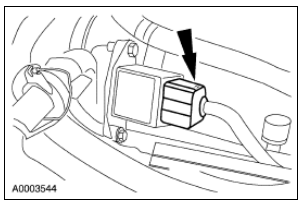
1. Remove the engine appearance cover.



2. Relieve the fuel pressure. For additional information, refer to Section 310-00 .

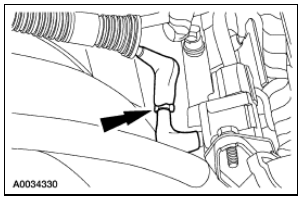
3. Remove the air cleaner outlet tube from the throttle body. For additional information, refer to Section 303-12 .

4. Disconnect the electrical connector from the fuel pressure sensor.



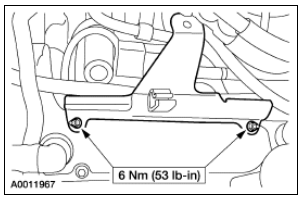
5. **NOTE:** The fuel pressure sensor vacuum hose must be disconnected at the jumper connection, not at the sensor.

   Disconnect the fuel pressure sensor vacuum hose.



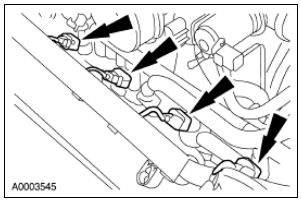
6. Disconnect the fuel line. For additional information, refer to Section 310-00 .

7. Remove the nuts and the engine appearance cover bracket.

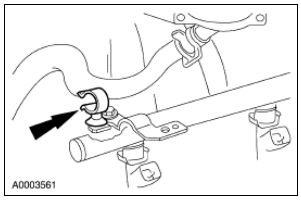


8. **NOTE:** RH side shown; LH side similar.

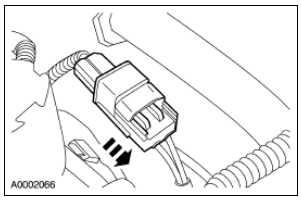
   Disconnect the eight fuel injector electrical connectors.



9. Remove the throttle body heater return hose from the retaining clip.

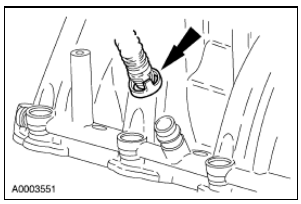


10. Disconnect the camshaft position (CMP) sensor.

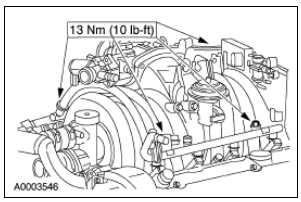


11. **NOTE:** Do not use tools to remove the air assist hose fittings. Squeeze the fitting by hand to disconnect the air assist hose.

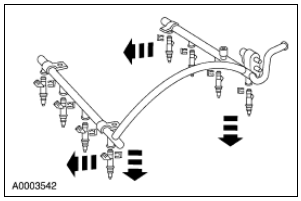
    Remove the air assist hose from both sides of the intake manifold and the idle air control (IAC) valve.



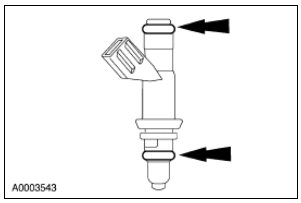
12. Remove the four bolts and the fuel injection supply manifold.



13. Remove the retaining clip and the fuel injectors from the fuel injection supply manifold.



14. Remove and discard the two O-ring seals from each fuel injector.



Installation

1. ⚠ **CAUTION: Install new O-ring seals.**

   NOTE: Lubricate new fuel injector O-ring seals with clean engine oil.

   To install, reverse the removal procedure.

General Specifications

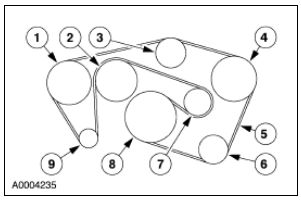
Item	Specification
Drive belt	Non neoprene 6K poly v belt
Press-on pulleys power steering pump and hydraulic cooling fan	Flush to end of shaft ± 0.25 mm (0.0010 inch)

Torque Specifications

Description	Nm	lb-ft
Belt idler pulley bolt	25	18
Drive belt tensioner bolt	50	37

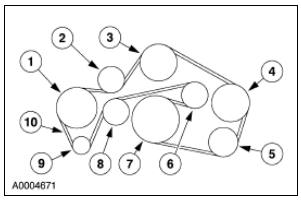
Accessory Drive

Component Locations 3.0L



Item	Part Number	Description
1	8C647	Hydraulic fan pump pulley
2	8A528	Water pump pulley
3	6C348	Belt idler pulley
4	3D673	Power steering pump pulley
5	8620	Drive belt
6	19D784	A/C clutch pulley
7	6B209	Drive belt tensioner
8	6316	Crankshaft vibration damper
9	10A352	Generator pulley

Component Locations 3.9L



Item	Part Number	Description
1	8C647	Hydraulic fan pump pulley
2	19A216	Belt idler pulley unflanged
3	8509	Water pump pulley
4	3D673	Power steering pump pulley
5	19D748	A/C clutch pulley
6	6B209	Drive belt tensioner
7	6316	Crankshaft vibration damper
8	19A216	Belt idler pulley flanged
9	10A352	Generator pulley
10	8620	Drive belt

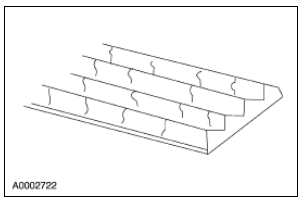
Accessory Drive

Inspection and Verification

1. Verify customer concern by running the engine.
2. Inspect the drive belt for chunking, fraying, wear, and pilling.
3. Check the drive belt for correct routing.

Drive Belt Cracking/Chunking/Wear

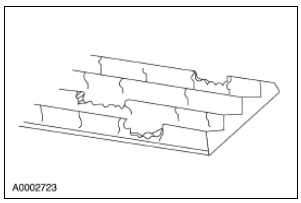
V-Ribbed Serpentine Drive Belt With Cracks Across Ribs



The accessory drive:

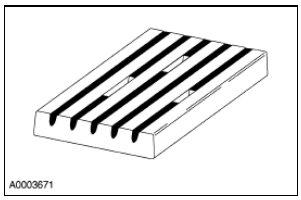
- has a single serpentine drive belt.
- has an automatic drive belt tensioner.
- does not require adjustment.

V- Ribbed Belt With Chunks of Rib Missing



V- Ribbed Belt With Pilling

NOTE: Pilling is an excessive build up in the V- grooves of the belt.



Symptom Chart

Symptom Chart

Component Tests

Drive Belt Noise/Flutter

Drive belt chirp occurs due to pulley misalignment or excessive pulley runout. It can be the result of a damaged pulley or an incorrectly aligned pulley.

To correct, determine the area where the noise comes from. Check each of the pulleys in that area with a straightedge to the crankshaft pulley. Look for accessory pulleys out of position in the fore/aft direction or at an angle to the straightedge.

NOTE: Do not apply any fluids or belt dressing to the belt or pulleys.

Drive belt squeal is an intermittent noise that occurs when the drive belt slips on a pulley during certain conditions, such as: engine start up, rapid engine acceleration, A/C clutch engagement, 1-2 shift and power steering loading.

Drive belt squeal can occur under certain conditions:

- if the A/C discharge pressure goes above specifications:
  - ♦ the A/C system is overcharged.
  - ♦ the A/C condenser core airflow is blocked.
- if the A/C OFF equalized pressure (the common discharged and suction pressure that occurs after several minutes) exceeds specifications.
- if any of the accessories are damaged, have a worn or damaged bearing, or internal torsional resistance above normal. All accessories should be rotatable by hand in the unloaded condition. If not, inspect the accessory.
- if fluid gets on the drive belt. This includes power steering fluid, engine coolant, engine oil or air conditioning system lubricant. If excessive fluid does get on the drive belt during repair, install a new drive belt.
- if the drive belt is too long. A drive belt that is too long will allow the drive belt tensioner arm to go all the way to the arm travel stop under certain load conditions, which will release tension to the drive belt. If the drive belt tensioner indicator is outside the normal installation wear range window, install a new drive belt.
- **NOTE:** The drive belt tensioner arm should rotate freely without binding.

  Install a new drive belt tensioner if the drive belt tensioner is worn or damaged.

Belt Tension

NOTE: Drive belt tension is not adjustable.

The drive belt tensioner automatically adjusts drive belt tension.

Belt Tensioner, Automatic

Check the automatic drive belt tensioner:

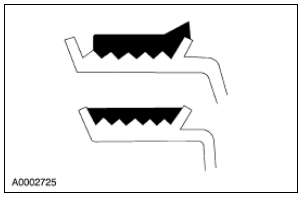
1. With the engine off, check for correct drive belt routing. For additional information, refer to Accessory Drive Belt - 3.0L or Accessory Drive Belt - 3.9L in this section. Repair as necessary.

2. Rotate the drive belt tensioner and check for a binding or frozen condition. Install new components as necessary.

Drive Belt Misalignment

⚠ CAUTION: Incorrect drive belt installation will cause excessive drive belt wear and may cause the drive belt to come off the drive pulleys.

Non-standard drive belts may track differently or incorrectly. If a drive belt tracks incorrectly, install a new drive belt to avoid performance failure or loss of the drive belt.



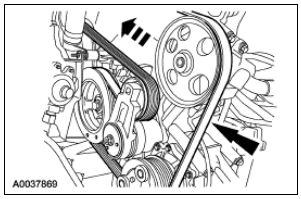
With the engine running, check drive belt tracking. If the edge of the drive belt rides beyond the edge of the pulleys, noise and premature wear may occur. Make sure the drive belt rides correctly on the pulley. If a drive belt tracking condition exists, proceed with the following:

- Visually check the drive belt tensioner for damage, especially the mounting pad surface. If the drive belt tensioner is not installed correctly, the mounting surface pad will be out of position. This will result in chirp and squeal noises.
- With the engine running, visually observe the grooves in the pulleys (not the pulley flanges or the pulley forward faces) for excessive wobble. Install new components as necessary.
- Check all accessories, mounting brackets and the drive belt tensioner for any interference that would prevent the component from mounting correctly. Correct any interference condition and recheck the drive belt tracking.
- Tighten all accessories, mounting brackets, and drive belt tensioner retaining hardware to specification. Recheck the drive belt tracking.

Accessory Drive Belt 3.0L

Removal

1. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
2. Rotate the tensioner counterclockwise and remove the drive belt.



Installation

1. ⚠ **CAUTION: Incorrect drive belt installation will cause premature drive belt failure.**

   NOTE: Make sure the drive belt (8620) is correctly installed on each pulley.

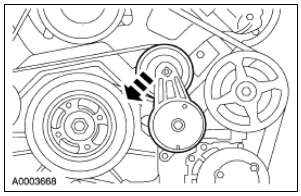
   To install, reverse the removal procedure.

   - Refer to component locations 3.0L for correct drive belt routing.

Accessory Drive Belt 3.9L

Removal

1. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
2. Rotate the tensioner counterclockwise and remove the drive belt from the pulley.



3. Remove the belt tensioner. For additional information, refer to Belt Tensioner in this section.

Installation

1. ⚠ **CAUTION: Incorrect drive belt installation will cause premature drive belt failure.**

   NOTE: Make sure the drive belt (8620) is correctly installed on each pulley.

   To install, reverse the removal procedure.

   - Refer to component locations 3.9L for correct drive belt routing.

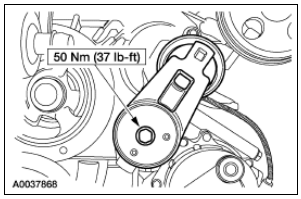
Belt Tensioner

Removal

1. Position the drive belt out of the way. For additional information, refer to Accessory Drive Belt - 3.0L or Accessory Drive Belt - 3.9L in this section.

2. **NOTE:** The 3.0L is shown, and the 3.9L is similar.

   Remove the bolt and the drive belt tensioner.



Installation

1. **NOTE:** Make sure locating pins are aligned with the holes in the front cover, and the belt is installed around the belt tensioner pulley.

   To install, reverse the removal procedure.

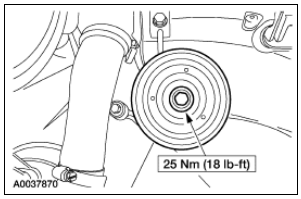
Accessory Drive Belt Idler Pulley

Removal

1. Position the drive belt out of the way. For additional information, refer to Accessory Drive Belt - 3.0L or Accessory Drive Belt - 3.9L in this section.

2. **NOTE:** The 3.0L belt idler pulley is shown, and the 3.9L is similar.

   Remove the bolt and the belt idler pulley.



Installation

1. To install, reverse the removal procedure.

General Specifications

Item	Specification
Starter motor normal load current draw (amperes)	130-220
Starting circuit maximum voltage drop (volts)	0.5

Torque Specifications

Description	Nm	lb-ft	lb-in
Starter motor bolts	25	18	
Starter motor ground cable nut	25	18	
Starter solenoid terminal nut (S-terminal)	6		53
Starter solenoid terminal nut (B-terminal)	12	9	

Starting System

The starting system consists of the following components:

- starter motor (11002)
- ignition switch
- digital transmission range (TR) sensor (7F293)
- starter relay

Starting System

Refer to Wiring Diagrams Cell 20 , Starting System for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Principles of Operation

Anti-Theft Intervention

The starting system is electronically controlled by the passive anti-theft system (PATS). The PATS recognizes the correct electronically coded ignition key and signals the instrument cluster to provide a ground for the starter relay. The energized relay provides voltage to the starter solenoid, thereby allowing the starter motor to activate.

Insection and Verification

⚠ WARNING: When carrying out underhood work in the vicinity of the starter motor, be aware that the heavy gauge battery input lead at the starter solenoid is "electrically hot" at all times. A protective cap or boot is provided over the terminal of this lead and must be installed after the repair procedure is completed. Failure to follow these instructions may result in personal injury.

⚠ WARNING: When working in area of the starter motor, be careful to avoid touching hot exhaust components. Failure to follow these instructions may result in personal injury.

NOTE: When working on the starter system, make sure the anti-theft system is deactivated.

1. Verify the customer concern by operating the system.

2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Starter motor • Brackets	• Battery • Auxiliary junction box (AJB) fuse F121 (30A) • Battery junction box (BJB) fuse F22 (20A)

	• Central junction box (CJB) fuse F201 (5A) • Starter relay • Loose or corroded connectors • Damaged wiring

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. If the concern remains after the inspection, determine the symptom(s) and go to the Symptom Chart.

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: THE ENGINE DOES NOT CRANK

PINPOINT TEST B: UNUSUAL STARTER NOISE

Component Tests

⚠ WARNING: When repairing the starter motor or carrying out other underhood work in the vicinity of the starter motor, be aware that the heavy gauge battery input lead at the starter solenoid is "electrically hot" at all times. Failure to follow these instructions may result in personal injury.

⚠ CAUTION: A protective cap or boot is provided over the battery input terminal on all vehicle lines and must be installed after repairing. Be sure to disconnect the battery ground cable before repairing the starter motor.

Connect the 73III Automotive Meter at the component terminal rather than at the wiring end connector. Making a connection at the wiring end connector could result in false readings because the meter will not pick up a high resistance between the wiring connector and the component.

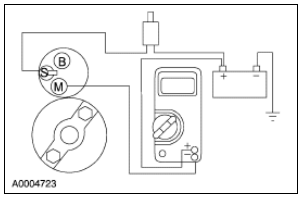
Starter Motor Motor Feed Circuit

1. Make sure the battery is fully charged. Carry out a battery load test. For additional information, refer to Section 414-00 .

2. Disconnect the inertia fuel shutoff (IFS) switch (9341).

3. Connect a remote starter switch between the starter solenoid S-terminal and the battery positive (+) terminal.

4. Connect the 73III Automotive Meter positive lead to the battery positive (+) post. Connect negative lead to the M-terminal.



5. Engage the remote starter switch. Read and record the voltage. The voltage reading should be 0.8 volt or less.

6. If the voltage reading is 0.8 volt or less, go to the Starter Motor-Ground Circuit Component Test.

7. If the voltage reading is greater than 0.8 volt, this is an indication of excessive resistance in the connections, the positive battery cable or in the starter solenoid. Move the 73III Automotive Meter negative lead to the starter solenoid B-terminal and repeat the test. If the voltage reading at the B-terminal is lower than 0.8 volt, the concern is either in the connections at the starter solenoid or in the solenoid contacts.

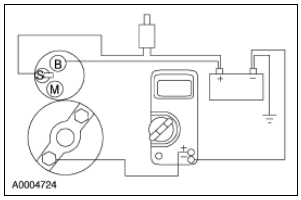
8. Remove the cables from solenoid B-, S- and M-terminals. Clean the cables and connections and reinstall the cables to the correct terminals. Repeat Steps 3 through 6. If the voltage drop reading is still greater than 0.8 volt when checked at the M-terminal or less than 0.8 volt when checked at the B-terminal, the concern is in the solenoid contacts. Install a new starter motor.

9. If the voltage reading taken at the solenoid B-terminal is still greater than 0.8 volt after cleaning the cables and the connections at the solenoid, the concern is either in the positive (+) battery cable connection or in the positive battery cable itself. Clean the positive (+) battery cable connection. If this does not solve the problem, install a new positive battery cable. Refer to Section 414-01 .

Starter Motor Ground Circuit

A slow cranking condition can be caused by resistance in the ground or return portion of the cranking circuit. Check the voltage drop in the ground circuit as follows:

1. Connect the 73III Automotive Meter positive lead to the starter motor housing (the connection must be clean and free of rust or grease). Connect the negative lead to the negative (-) battery terminal.



2. Engage the remote starter switch and crank the engine. Read and record the voltage reading. The reading should be 0.5 volt or less.

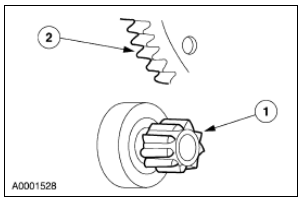
3. If the voltage is more than 0.5 volt, clean the negative cable connections at the battery, the body ground connections, and the starter ground connections. Retest.

4. If the voltage is more than 0.5 volt, install a new cable. If the voltage reading is less than 0.5 volt and the engine still cranks slowly, install a new starter motor.

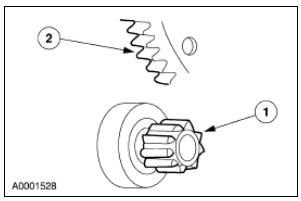
Starter Drive and Flywheel Ring Gear Inspection

1. Remove the starter motor (11002). For additional information, refer to Starter Motor - 3.0L and Starter Motor - 3.9L in this section.

2. Check the wear patterns on the (1) starter drive gear and the (2) flywheel ring gear. If the wear pattern is normal, install the starter motor. For additional information, refer to Starter Motor - 3.0L and Starter Motor - 3.9L in this section.



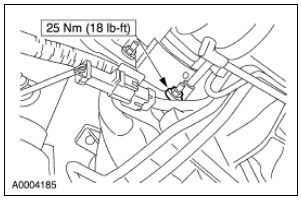
3. If the (1) starter drive gear and the (2) flywheel ring gear are not fully meshing or the gears are milled or damaged, install a new starter motor and, if necessary, a new flywheel gear. For additional information, refer to Starter Motor - 3.0L and Starter Motor - 3.9L in this section or Section 303-01A .



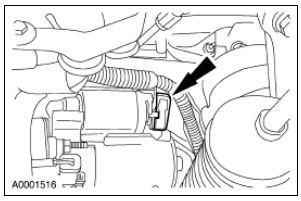
Starter Motor 3.0L

Removal

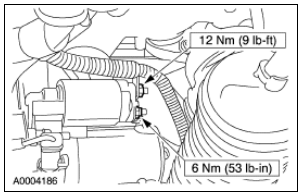
1. Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Disconnect the ground strap.



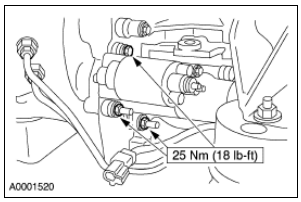
4. Remove the cover.



5. Remove the nuts and position the cables aside.



6. Remove the bolts, two stud bolts and the starter motor (11002).



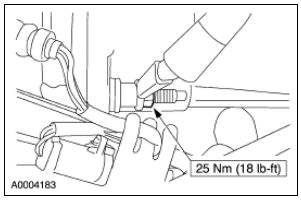
Installation

1. To install, reverse the removal procedure.

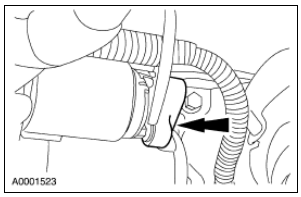
Starter Motor 3.9L

Removal

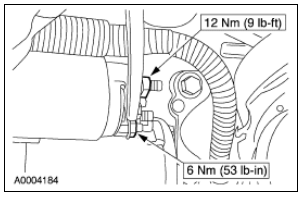
1. Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Disconnect the ground strap.



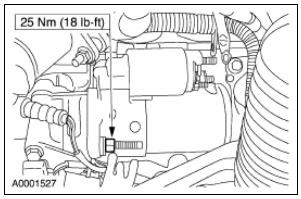
4. Remove the cover.



5. Remove the nuts and position the cables aside.



6. Remove the bolt, stud bolt and the starter motor (11002).



Installation

1. To install, reverse the removal procedure.

General Specifications

Item	Specification
Firing order	1-4-2-5-3-6
Spark plug type	AGSF-32FS
Spark plug gap	1.30-1.45 mm (0.051-0.057 inch)
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A	ESE-M1C171-A

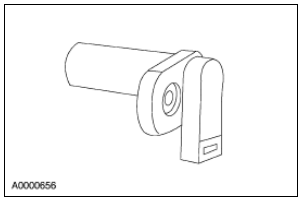
Torque Specifications

Description	Nm	lb-ft	lb-in
Spark plugs	15	11	
Ignition coil bolts	6		53

Engine Ignition

The electronic ignition (EI) system is a coil-on-plug (COP) ignition system. The COP ignition system consists of the following components:

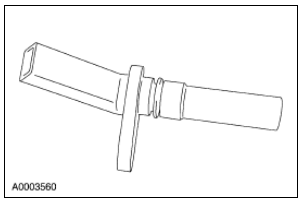
- crankshaft position (CKP) sensor
- camshaft position (CMP) sensor
- ignition coils
- spark plugs



The crankshaft position sensor:

- is a variable reluctance sensor.
- is mounted on the engine front cover.
- is triggered by a 36-minus-1 tooth trigger wheel mounted on the crankshaft.
- provides base timing and crankshaft speed (rpm) to the powertrain control module (PCM).

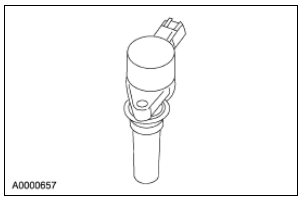
Refer to Section 303-14 for removal and installation of the crankshaft position sensor.



The camshaft position sensor:

- sends the powertrain control module (PCM) a signal indicating camshaft position used for fuel synchronization.

Refer to Section 303-14 for removal and installation of the camshaft position sensor.



The six separate ignition coils:

- convert low voltage signals from the powertrain control module to high voltage pulses.
- produce the high voltage pulses for the spark plugs.
- are connected directly to each spark plug.

The spark plugs:

- convert a high voltage pulse into a spark which ignites the fuel and air mixture.
- originally installed on the vehicle have a platinum-enhanced active electrode for long life.

Engine Ignition

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

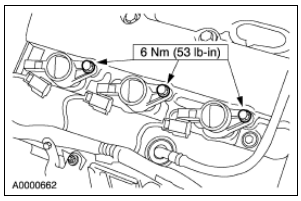
Ignition Coil

Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A	ESE-M1C171-A

Removal and Installation

1. Remove the engine appearance cover.
2. To access the RH bank ignition coils, remove the upper intake manifold. For additional information, refer to Section 303-01A .
3. Disconnect the electrical connector from the ignition coils.
4. Remove the bolts.



5. Remove the ignition coils.
6. **NOTE:** Apply silicone brake caliper grease and dielectric compound to the inside of the ignition coil boots.

   NOTE: Verify the ignition coils are seated and the boots are not damaged. If the boots are damaged, install a new ignition coil.

   To install, reverse the removal procedure.

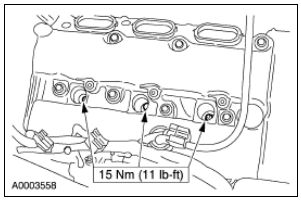
Spark Plug

Removal

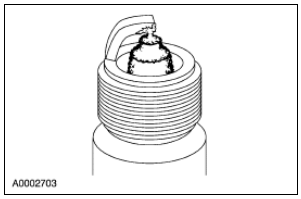
1. Remove the ignition coil. For additional information, refer to Ignition Coil in this section.

2. **NOTE:** Use compressed air to remove any foreign material from the spark plug well before removing the spark plugs.

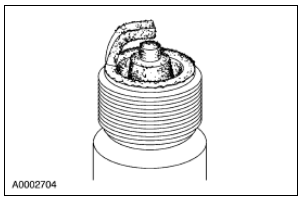
   Remove the spark plugs.



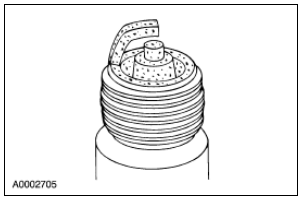
3. Inspect for a bridged gap.
   - Check for deposit build-up closing the gap between electrodes. Deposits are caused by oil or carbon fouling.
   - Clean the spark plug.



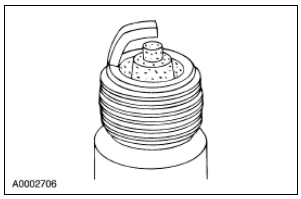
4. Inspect for oil fouling, identified by wet, black deposits on the insulator shell bore electrodes. This is caused by excessive oil entering the combustion chamber through worn rings and pistons, excessive valve-to-guide clearance or worn or loose bearings.
   - Correct the oil leak concern.
   - Install a new spark plug.



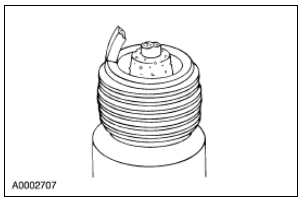
5. Inspect for carbon fouling, identified by black, dry, fluffy carbon deposits on the insulator tips, exposed shell surfaces and electrodes. This is caused by a spark plug with an incorrect heat range, dirty air cleaner, too rich a fuel mixture or excessive idling.
   - Clean the spark plug.



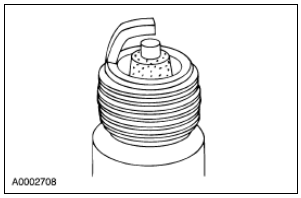
6. Inspect for normal burning.
    - Check for light tan or gray deposits on the firing tip.



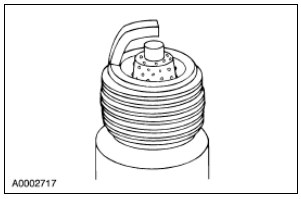
7. Inspect for pre-ignition, identified by melted electrodes and possibly a damaged insulator. Metallic deposits on the insulator indicate engine damage. Pre-ignition may be caused by incorrect ignition timing, wrong type of fuel or the installation of a heli-coil insert in place of the spark plug threads.
    - Install a new spark plug.



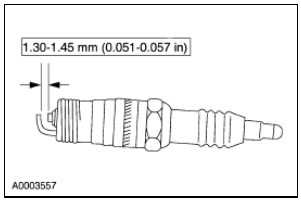
8. Inspect for overheating, identified by a white or light gray insulator with small black or gray-brown spots with bluish-burnt appearance of electrodes. This is caused by engine overheating, wrong type of fuel, loose spark plugs, spark plugs with an incorrect heat range, low fuel pump pressure or incorrect ignition timing.
    - Install a new spark plug.



9. Inspect for fused spot deposits, identified by melted or spotty deposits resembling bubbles or blisters. This is caused by sudden acceleration.
    - Clean the spark plug.



10. Adjust the spark plug gap as necessary.



Installation

1. To install, reverse the removal procedure.

General Specifications

Item	Specification
Firing order	1-5-4-2-6-3-7-8
Spark plug type	AGSP-32F
Spark plug gap	0.99-1.09 mm (0.039-0.043 inch)
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A	ESE-M1C171-A

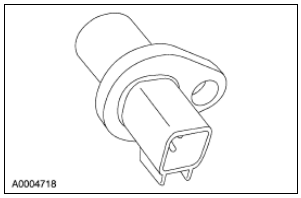
Torque Specifications

Description	Nm	lb-ft	lb-in
Ignition coil cover bolts	5		44
Spark plugs	26	19	
Ignition coil bolts	5		44

Engine Ignition

The electronic ignition (EI) system is a coil-on-plug (COP) ignition system. The COP ignition system consists of the following components:

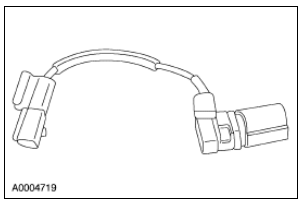
- crankshaft position (CKP) sensor
- camshaft position (CMP) sensor
- ignition coils
- spark plugs



The crankshaft position sensor:

- is a variable reluctance sensor.
- is mounted on the sump body under the engine.
- is triggered by the flywheel.
- provides base timing and crankshaft speed (rpm) to the powertrain control module (PCM).

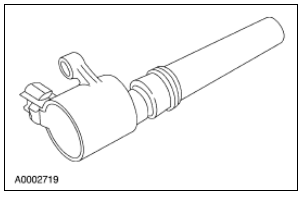
Refer to Section 303-14 for removal and installation of the crankshaft position sensor.



The camshaft position sensor:

- sends the powertrain control module (PCM) a signal indicating camshaft position used for fuel synchronization.
- indicates top dead center.

Refer to Section 303-14 for removal and installation of the camshaft position sensor.



The eight separate ignition coils:

- convert low voltage signals from the powertrain control module to high voltage pulses.
- produce the high voltage pulses for the spark plugs.
- are connected directly to each spark plug.

The spark plugs:

- convert the high voltage pulse into a spark which ignites the fuel and air mixture.
- originally installed on the vehicle have a platinum-enhanced active electrode for long life.

Engine Ignition

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Ignition Coil

Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound D7AZ-19A331-A	ESE-M1C171-A

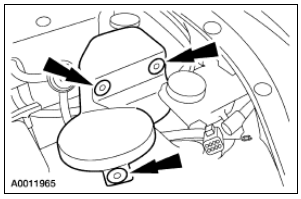
Removal and Installation

Right side ignition coils

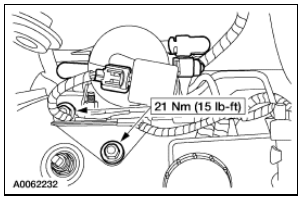
1. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .

Left side ignition coils

2. Remove the evaporative emission canister purge valve cover.



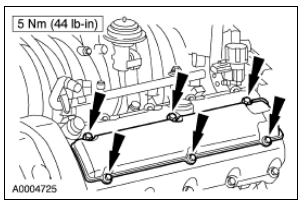
3. Remove the evaporative emission canister purge valve bracket nuts and position aside.



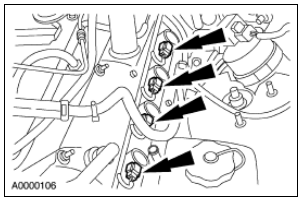
Left and right side ignition coils

4. **NOTE:** Left side shown, right side similar.

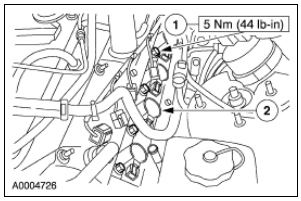
   Remove the bolts and the ignition coil cover.



5. Disconnect the electrical connector from each ignition coil.



6. Remove the ignition coils.
    1. Remove the bolts.
    2. Remove the ignition coils.



7. **NOTE:** Apply silicone brake caliper grease and dielectric compound to the inside of ignition coil boots.

   To install, reverse the removal procedure.

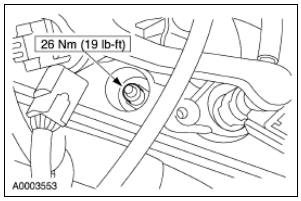
Spark Plugs

Removal and Installation

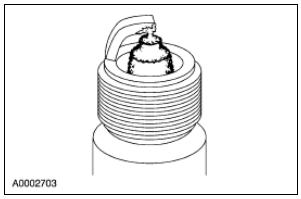
1. Remove the ignition coil. For additional information, refer to Ignition Coil in this section.

2. **NOTE:** Use compressed air to remove any foreign material from the spark plug well before removing the spark plugs.

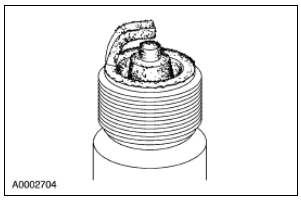
   Remove the spark plugs.



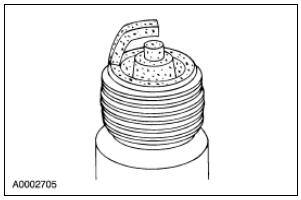
3. Inspect for a bridged gap.
   - Check for deposit build-up closing the gap between electrodes. Deposits are caused by oil or carbon fouling.
   - Clean the spark plug.



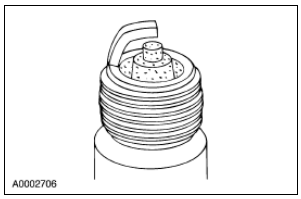
4. Inspect for oil fouling, identified by wet, black deposits on the insulator shell bore electrodes. This is caused by excessive oil entering the combustion chamber through worn rings and pistons, excessive valve-to-guide clearance or worn or loose bearings.
   - Correct the oil leak concern.
   - Install a new spark plug.



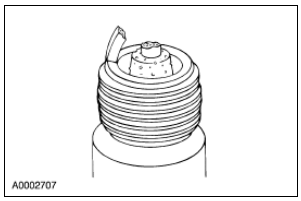
5. Inspect for carbon fouling, identified by black, dry, fluffy carbon deposits on the insulator tips, exposed shell surfaces and electrodes. This is caused by a spark plug with an incorrect heat range, dirty air cleaner, too rich a fuel mixture or excessive idling
   - Clean the spark plug.



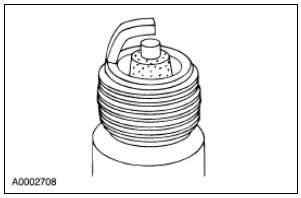
6. Inspect for normal burning.
    - Check for light tan or gray deposits on the firing tip.



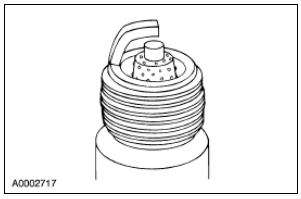
7. Inspect for pre-ignition, identified by melted electrodes and possibly a damaged insulator. Metallic deposits on the insulator indicate engine damage. Pre-ignition may be caused by incorrect ignition timing, wrong type of fuel or the installation of a heli-coil insert in place of the spark plug threads.
    - Install a new spark plug.



8. Inspect for overheating, identified by a white or light gray insulator with small black or gray-brown spots with bluish-burnt appearance of electrodes. This is caused by engine overheating, wrong type of fuel, loose spark plugs, spark plugs with an incorrect heat range, low fuel pump pressure or incorrect ignition timing.
    - Install a new spark plug.

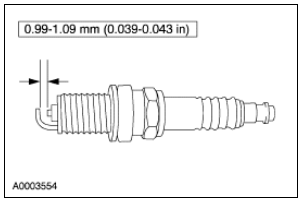


9. Inspect for fused spot deposits, identified by melted or spotty deposits resembling bubbles or blisters. This is caused by sudden acceleration.
    - Clean the spark plug.



10. Inspect to make sure the platinum tip is present.

11. Adjust the spark plug gap as necessary.



12. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
EGR valve bolts	25	18	
EGR valve to exhaust manifold tube fittings	[a]		
EVR solenoid	5		44
Differential pressure feedback EGR	6		53
Cross vehicle support	20	15	
Crankcase vent oil separator	10		89
Secondary air tube	35	26	
Secondary air tube bolt	10		89
Secondary air valve	10		89
Secondary air pump	10		89
Exhaust manifold to secondary air tube fitting.	42	31	

[a] Refer to the procedure in this section.

Engine Emission Control

⚠ CAUTION: Do not remove any part of the engine emission control system. Operating the engine without the engine emission control system will reduce fuel economy and engine ventilation. This will weaken engine performance and shorten engine life.

The engine emission control consists of the:

- positive crankcase ventilation (PCV) system.
- exhaust gas recirculation (EGR) system.
- secondary air system (3.0L only).

The Vehicle Emission Control Information (VECI) decal shows:

- the components of the emission control system.
- the correct vacuum hose routing.

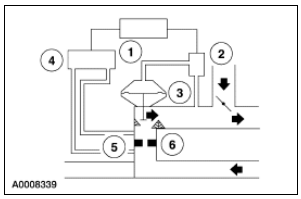
For additional information, refer to Section 100-01 .

The PCV system uses intake manifold vacuum to ventilate the crankcase and return the fumes to the intake manifold for combustion.

The PCV valve (3.0L only):

- controls the amount of ventilating air and blow-by gases going to the intake manifold.
- prevents a backfire from reaching the crankcase.

EGR System Components



Item	Part Number	Description
1	12A650	Powertrain control module
2	9J459	EGR vacuum regulator solenoid
3	9D475	EGR valve
4	9J433	Differential pressure feedback EGR
5		Metering orifice (part of 9D477)
6	9D477	EGR valve-to-exhaust manifold tube

The EGR system returns a portion of the exhaust gas to the intake manifold to reduce the combustion temperature. This results in lower nitrous oxide formation.

The EGR vacuum regulator solenoid (9J459) uses input from the PCM to change the EGR valve operation.

The EGR valve-to-exhaust manifold tube:

- connects the exhaust manifold (9430) to the EGR valve.
- has two tubes connecting to the differential pressure feedback EGR for EGR flow monitoring.

The differential pressure feedback EGR:

- monitors the EGR flow rate through the EGR valve-to-exhaust manifold tube.
- sends an EGR flow rate signal to the PCM.

The powertrain control module (PCM) (12A650) controls the EGR vacuum regulator solenoid. The EGR vacuum regulator solenoid controls the vacuum to the EGR valve. When the EGR valve opens, exhaust gas flows to the intake manifold. The differential pressure feedback EGR (9J433) measures the flow through the EGR valve from the exhaust manifold tube (9D477) and sends a signal to the PCM. A metering orifice in the EGR valve-to-exhaust manifold tube restricts the flow rate when the EGR valve (9D475) is open.

The secondary air system is used to reduce hydrocarbons (HC) by introducing oxygen into the exhaust gas stream. It operates at startup for the first 90 seconds.

Engine Emission Control

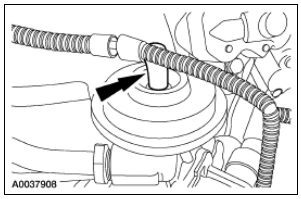
Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Exhaust Gas Recirculation (EGR) Valve

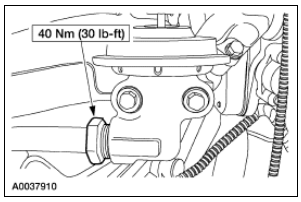
Removal and Installation

NOTE: The 3.0L is shown, the 3.9L is similar.

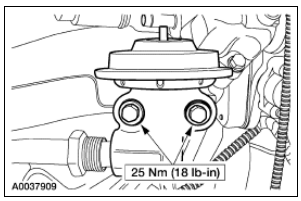
1. Disconnect the vacuum hose.



2. Disconnect the exhaust gas recirculation (EGR) tube from the EGR valve.



3. Remove the EGR valve.
   - Remove the bolts and the EGR valve.
   - Remove and discard the gasket and clean the sealing surfaces.

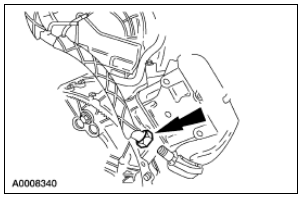


4. To install, reverse the removal procedure.
   - Install a new gasket.

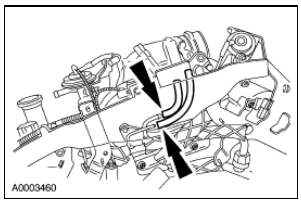
Exhaust Manifold To Exhaust Gas Recirculation (EGR) Valve Tube 3.0L

Removal

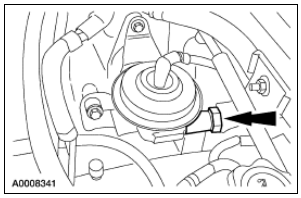
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Disconnect the EGR tube from the exhaust manifold.



3. Lower the vehicle.
4. Disconnect the differential pressure feedback EGR hoses.

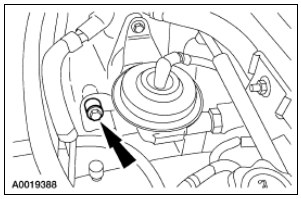


5. Disconnect the EGR tube from the EGR valve.
   - Remove the tube from the vehicle.

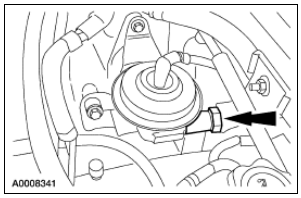


Installation

1. Loosen the two EGR valve bolts.

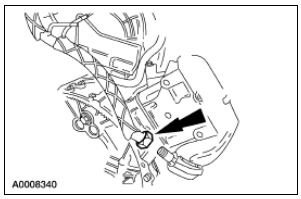


2. Hand-tighten the EGR valve tube to the EGR valve.



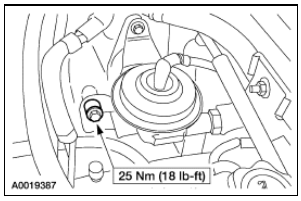
3. Raise and support the vehicle. For additional information, refer to Section 100-02 .

4. Tighten the EGR valve tube to the exhaust manifold in two stages:
   - Stage 1: Hand-tighten the EGR valve tube to the exhaust manifold.
   - Stage 2: Tighten the EGR valve tube to 40 Nm (30 lb-ft).

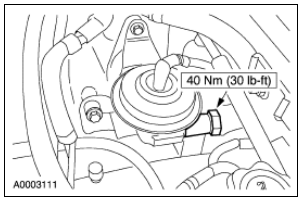


5. Lower the vehicle.

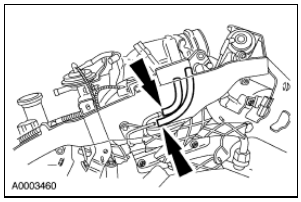
6. Tighten the two EGR valve bolts.



7. Tighten the EGR valve tube to the EGR valve.



8. Connect the differential pressure feedback EGR hoses.



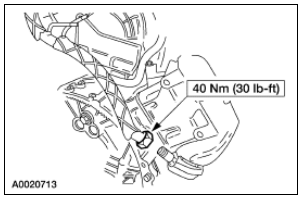
Exhaust Manifold To Exhaust Gas Recirculation (EGR) Valve Tube 3.9L

Removal and Installation

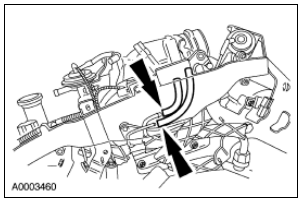
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Remove the cabin air plenum. For additional information, refer to Section 412-01 .

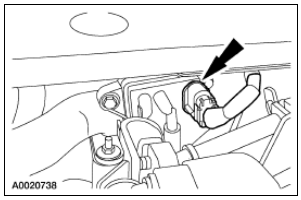
3. Disconnect the exhaust gas recirculation (EGR) tube from the exhaust manifold.
   - Loosen the compression nut.



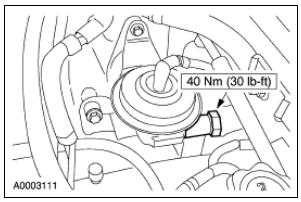
4. Disconnect the differential pressure feedback EGR (DPFE) hoses.



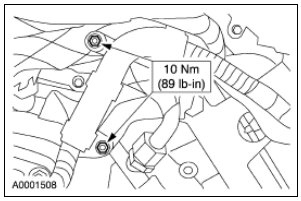
5. Disconnect the DPFE electrical connector.



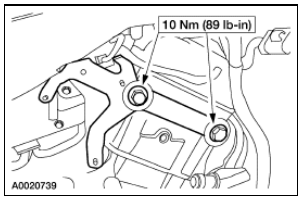
6. Disconnect the EGR tube from the EGR valve.
   - Loosen the compression nut.



7. Position the wire harness bracket aside.
   - Remove the nuts.



8. Position the bracket aside.
   - Remove the bolts.



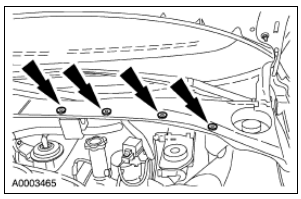
9. Remove the EGR tube from the vehicle.

10. To install, reverse the removal procedure.

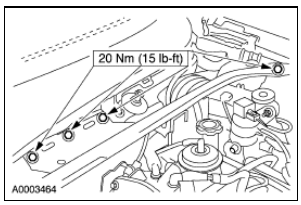
Differential Pressure Feedback Exhaust Gas Recirculation (EGR) System 3.0L

Removal and Installation

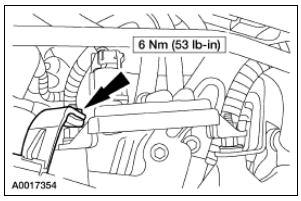
1. Remove the cowl vent screen. For additional information, refer to Section 501-02 .



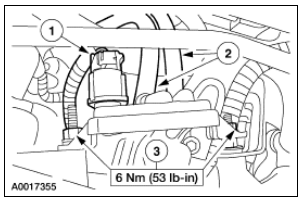
2. Remove the seven bolts and position the cross vehicle support out of the way.



3. Remove the nut and the throttle cable bracket.



4. Remove the differential pressure feedback EGR.
    1. Disconnect the electrical connector.
    2. Disconnect the hoses.
    3. Remove the bolts and the differential pressure feedback EGR.

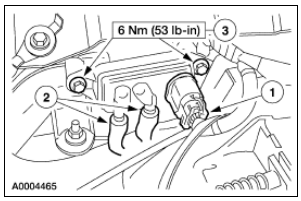


5. To install, reverse the removal procedure.

Differential Pressure Feedback Exhaust Gas Recirculation (EGR) System 3.9L

Removal and Installation

1. Remove the differential pressure feedback EGR.
    1. Disconnect the electrical connector.
    2. Disconnect the hoses.
    3. Remove the bolts and the differential pressure feedback EGR.



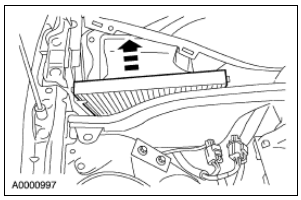
2. To install, reverse the removal procedure.

Exhaust Gas Recirculation (EGR) Vacuum Regulator Solenoid 3.0L

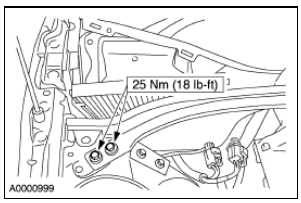
Removal and Installation

1. Remove the cowl vent screen. For additional information, refer to Section 501-02 .

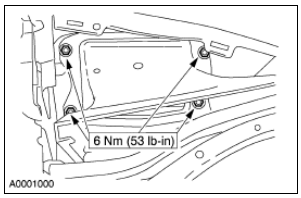
2. Push on the RH corner of the filter to release the clip. Release the LH clip and remove the cabin air filter.



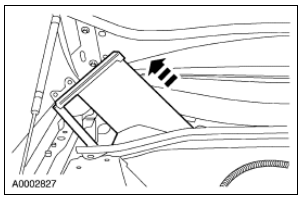
3. Remove the seven bolts and remove the cross-vehicle support.



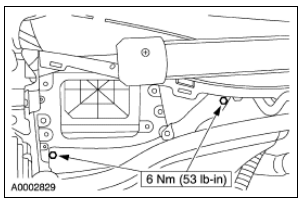
4. Remove the bolts.



5. Remove the cabin air filter housing by lifting the outboard side then removing the housing.

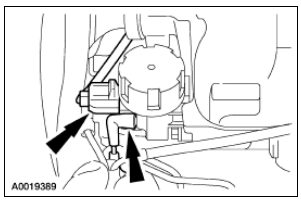


6. Remove the three bolts and remove the plenum panel.

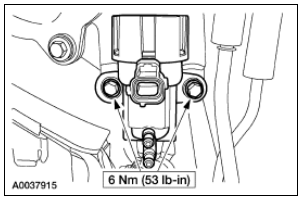


7. Disconnect the EGR vacuum regulator solenoid.
   - Disconnect the electrical connector.

- Disconnect the vacuum hoses.



8. Remove the EGR vacuum regulator solenoid.
   - Remove the bolts.

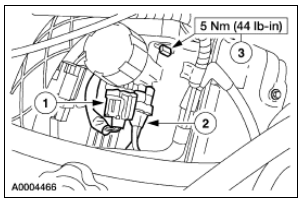


9. To install, reverse the removal procedure.

Exhaust Gas Recirculation (EGR) Vacuum Regulator Solenoid 3.9L

Removal and Installation

1. Remove the EGR vacuum regulator (EVR).
    1. Disconnect the electrical connector.
    2. Disconnect the vacuum hoses.
    3. Remove the bolts and EVR.



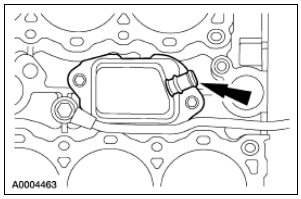
2. To install, reverse the removal procedure.

Positive Crankcase Ventilation (PCV) Valve 3.0L

Removal and Installation

1. Remove the lower intake manifold. For additional information, refer to Section 303-01A .

2. Remove the positive crankcase ventilation (PCV) valve from the oil separator.

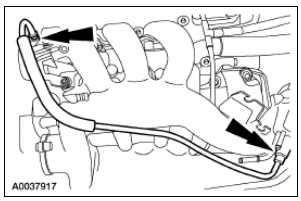


3. To install, reverse the removal procedure.

Positive Crankcase Ventilation (PCV) Hose 3.0L

Removal and Installation

1. Disconnect and remove the PCV ventilation hose.



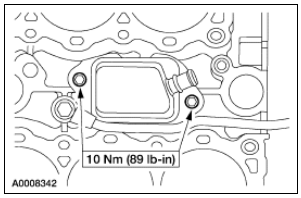
2. To install, reverse the removal procedure.

Crankcase Vent Oil Separator 3.0L

Removal and Installation

1. Remove the LH cylinder head. For additional information, refer to Section 303-01A .

2. Remove the bolts and the oil separator. Discard the gasket.



3. To install, reverse the removal procedure.
   - Install a new gasket.

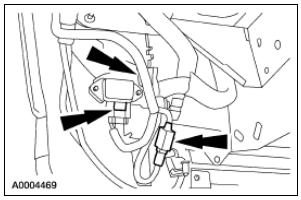
Secondary Air Pump 3.0L

Removal and Installation

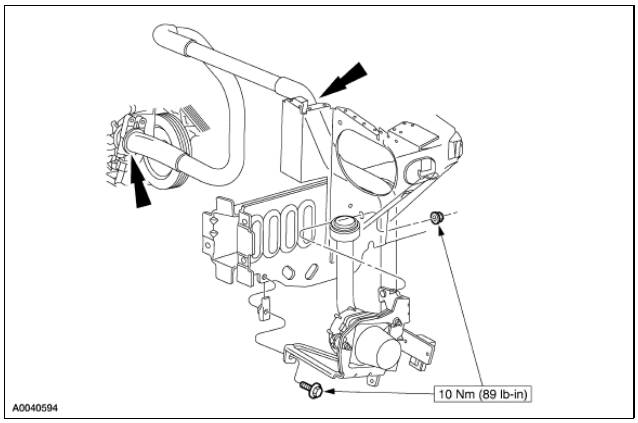
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Remove the inner fender splash shield.

3. Disconnect the electrical connectors and separate the wiring from the secondary air pump.



4. Remove the secondary air pump.
   - Disconnect and remove the pump-to-valve air tube.
   - Remove the bolt and nut, remove the secondary air pump.



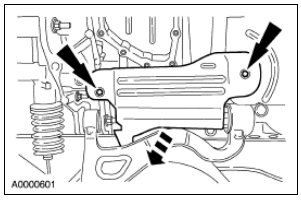
5. To install, reverse the removal procedure.

Secondary Air Valve 3.0L

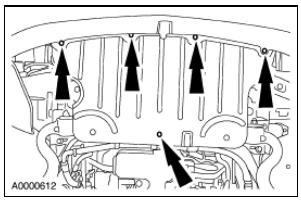
Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. **NOTE:** LH shown; RH similar.

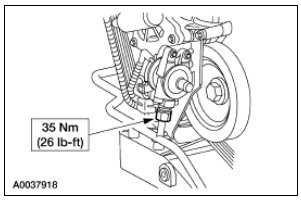
   Remove the LH and the RH side splash shields.



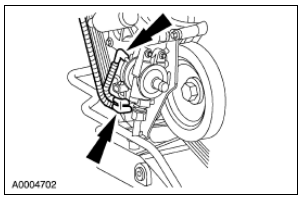
3. Remove the center splash shield.



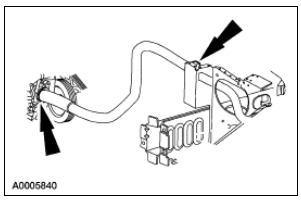
4. Disconnect the secondary air tube from the valve.



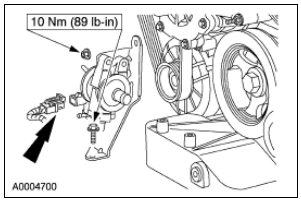
5. Disconnect the vacuum hoses from the secondary air valve.



6. Disconnect and remove the pump-to-valve air tube.



7. Disconnect the electrical connector. Remove the nut and bolt. Remove the valve.



8. To install, reverse the removal procedure.

Secondary Air Valve Tube, 3.0L

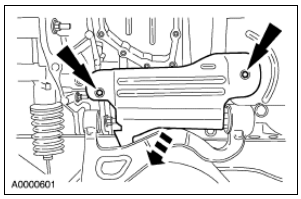
Removal and Installation

1. Remove the accessory drive belt from the generator pulley. For additional information, refer to Section 303-05 .

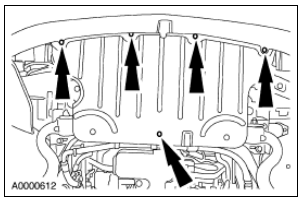
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .

3. **NOTE:** LH shown, RH similar.

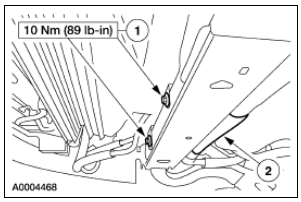
   Remove the LH and the RH splash shields.



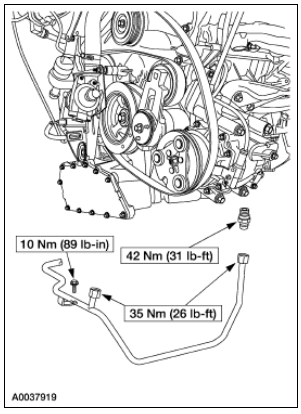
4. Remove the center splash shield.



5. Disconnect the A/C hose.



6. Remove the secondary air tube.



7. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
ACL outlet tube clamp screws	4	35
ACL outlet tube support nut	4	35

Intake Air Distribution And Filtering

The air intake system consists of the:

- air cleaner (ACL) (inlet) (9600)
- air cleaner (ACL) element (9601)
- mass airflow (MAF) sensor (12B579)
- intake air temperature (IAT) sensor (12A697)
- air cleaner outlet tube (9F805)

The air intake system:

- cleans intake air with a replaceable air cleaner element.
- measures airflow with the MAF sensor. For additional information, refer to Section 303-14 .
- measures air temperature with the IAT. For additional information, refer to Section 303-14 .

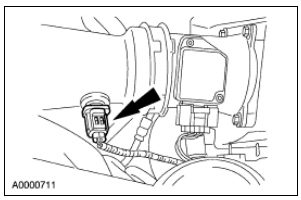
Intake Air Distribution And Filtering

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

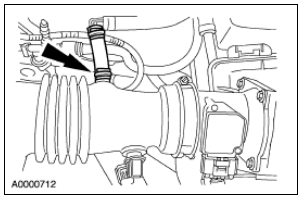
Air Cleaner Outlet Pipe 3.0L

Removal and Installation

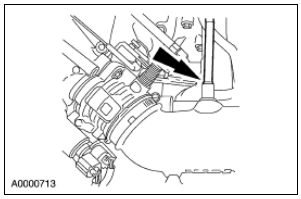
1. Disconnect the intake air temperature (IAT) sensor electrical connector.



2. Disconnect the aspirator hose from the air cleaner outlet tube (9F805).

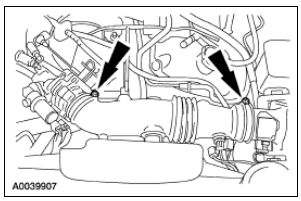


3. Disconnect the positive crankcase ventilation hose (6853).



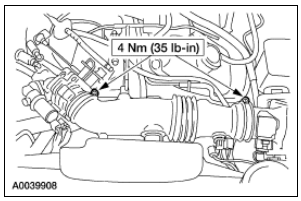
4. ⚠ **CAUTION: Disconnect the air cleaner outlet tube at the throttle body first to avoid damage to the resonator on the bottom of the air cleaner outlet tube.**

   Loosen the hose clamp screws and remove the air cleaner outlet tube.



5. ⚠ **CAUTION: The air cleaner outlet tube should be securely sealed to prevent unmetered air from entering the engine.**

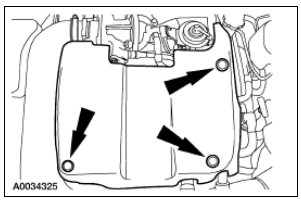
   To install, reverse the removal procedure.



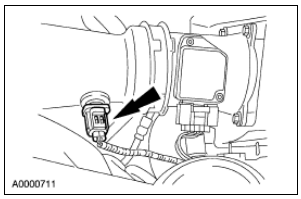
Air Cleaner Outlet Pipe 3.9L

Removal and Installation

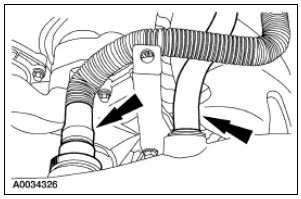
1. Remove the engine appearance cover (6N030).



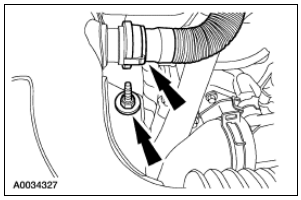
2. Disconnect the intake air temperature (IAT) sensor electrical connector.



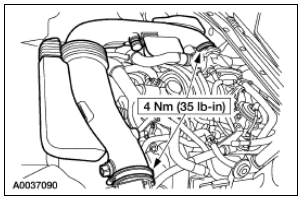
3. Disconnect the full load breather hose (9P903) and the engine emission hose.



4. Disconnect the idle air control valve inlet tube (9K617) and remove the air cleaner outlet pipe support nut.



5. Loosen the hose clamp screws and remove the air cleaner outlet pipe (9F805).



6. ⚠ **CAUTION: The air cleaner outlet tube should be securely sealed to prevent unmetered air from entering the engine.**

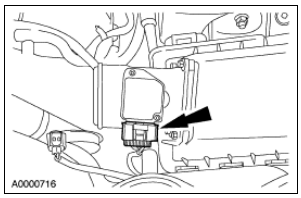
   To install, reverse the removal procedure.

Air Cleaner Outlet

Removal

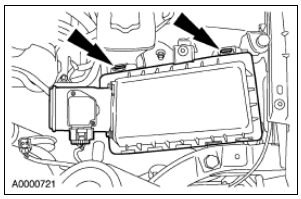
1. Remove the air cleaner outlet tube (9F805). For additional information, refer to Air Cleaner Outlet Pipe 3.0L or Air Cleaner Outlet Pipe 3.9L in this section.

2. Disconnect the electrical connector from the mass airflow (MAF) sensor (12B579).



3. **NOTE:** No tools are needed to remove the air cleaner (ACL) element (9601). The following removal and installation steps should be carried out using hands only.

   Open the air cleaner snaps and remove the outlet side of the air cleaner (9600).



4. If necessary, remove the MAF sensor from the outlet side of the air cleaner. For additional information, refer to Section 303-14 .

Installation

⚠ CAUTION: The grommet used to seal the air cleaner housing must be fully seated. Failure to do so will result in unmetered air entering the engine.

NOTE: Use the alignment notches to correctly align the inlet side and the outlet side of the air cleaner.

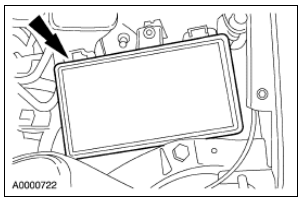
1. To install, reverse the removal procedure.

Air Cleaner Inlet

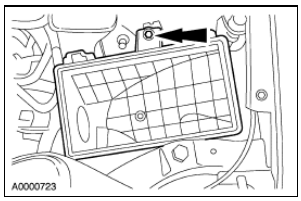
Removal

1. Remove the outlet side of the air cleaner (ACL) (9600). For additional information, refer to Air Cleaner Outlet in this section.

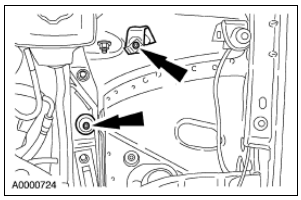
2. Remove the air cleaner element (9601).



3. Remove the screw and the inlet side of the ACL.



4. If necessary, remove the grommet and bracket.



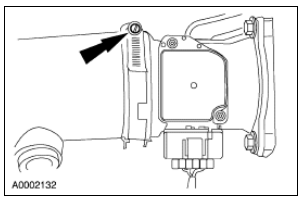
Installation

1. To install, reverse the removal procedure.

Air Cleaner Element

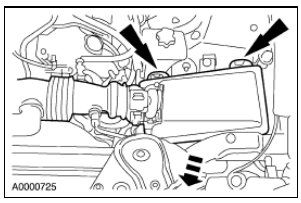
Removal

1. Loosen the clamp on the air cleaner outlet tube (9F805) at the mass airflow (MAF) sensor (12B579).

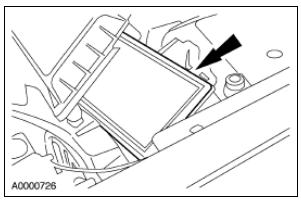


2. **NOTE:** No tools are needed to remove the air cleaner (ACL) element (9601). The following removal and installation steps should be carried out using hands only.

   Open the air cleaner snaps and set the outlet side of the air cleaner (ACL) (9600) aside.



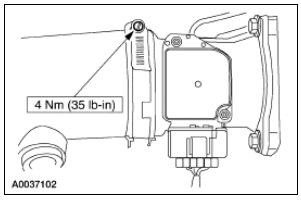
3. Remove the air cleaner (ACL) element (9601).



Installation

⚠ CAUTION: The grommet used to seal the air cleaner housing must be fully seated. Failure to do so will result in unmetered air entering the engine.

1. To install, reverse the removal procedure.



General Specifications

Item	Specification
MERPOL® O-ring Seal Lubricant	ESE-M99B144-B

Torque Specifications

Description	Nm	lb-ft	lb-in
Evaporative emission canister and bracket assembly bolts	10		89
Evaporative canister purge valve nuts	8		71
Evaporative canister purge valve bracket nuts	10		89
Differential bolt	114	84	

Evaporative Emissions

The evaporative emission (EVAP) system:

- is equipped with an on-board refueling vapor recovery (ORVR) system.
- prevents hydrocarbon emissions from reaching the atmosphere.
- stores fuel vapors in the EVAP canister that are generated during vehicle refueling, vehicle operation or hot soak until they can be consumed by the engine.
- routes the stored fuel vapors to the engine during engine operation.
- is controlled by the powertrain control module (PCM) which uses various sensor inputs to calculate the desired amount of purge flow. The PCM regulates the purge flow, induced by the application of intake manifold vacuum, by varying the duty cycle applied to the EVAP canister purge valve.
- has an EVAP test port for test purposes.

The fuel vapors are routed:

- from the fuel tank through the fuel vapor control valve and fuel vapor vent valve.
- to the EVAP canister through a vapor line.
- to the engine when the EVAP canister purge valve is opened by the PCM.

The fuel tank pressure (FTP) sensor:

- monitors the pressure levels in the fuel tank.
- communicates the pressure reading to the PCM during the OBDII leak test.
- is permanently attached to the fuel vapor control valve tube assembly.

The evaporative emission canister assembly:

- is located above the rear subframe.
- contains activated carbon.
- stores fuel vapors.

The fuel tank filler cap:

- relieves system pressure above 17 kPa (68.24 inches H_2O).
- relieves system vacuum below 5.65 kPa (22.68 inches H_2O).

The canister vent solenoid:

- is normally open.
- seals the EVAP system for the inspection and maintenance (I/M 240) test and OBDII leak and pressure tests.
- is mounted on the EVAP canister bracket assembly.
- is repaired as a separate item.

The evaporative emission (EVAP) canister purge valve:

- is normally closed.
- regulates purging of the EVAP canister.
- is controlled by the PCM.
- is located in the engine compartment on the LH strut tower.

The fuel vapor vent (FVV) valve:

- is permanently mounted to the fuel tank.
- prevents suspended liquid fuel from being drawn into the EVAP canister along with the fuel vapors.

The fuel vapor control valve:

- is permanently mounted to the fuel tank.
- controls fuel tank refueling fill level.
- prevents suspended liquid fuel from being drawn into the EVAP canister along with the fuel vapors.
- relieves system pressure above 14 kPa (56.21 inches H_2O).

The underbody fuel supply and vapor tube assembly:

- is located under the LH rocker panel.
- includes both the fuel supply line and the EVAP canister purge outlet tube.
- supplies fuel from the fuel pump to the fuel filter.
- routes fuel vapors from the fuel vapor control valve tube assembly to the engine compartment fuel supply and vapor tube.
- is repaired as an assembly.

The engine compartment fuel supply and vapor tube assembly:

- is located on the LH side of the engine compartment.
- supplies fuel from the fuel filter to the fuel injection supply manifold.
- routes fuel vapors from the underbody fuel supply and vapor tube assembly to the EVAP canister purge valve.
- is repaired as an assembly.

The evaporative emission (EVAP) system monitor:

- is a self-test strategy within the PCM, which tests the integrity of the EVAP system.
- monitors the EVAP system for leaks.
- monitors electronic EVAP components for irrationally high or low voltages.
- monitors for correct EVAP system operation.
- uses negative leak test method to test and activate the EVAP system.

The evaporative emission (EVAP) test port:

- is used to connect the Evaporative Emission System Leak Tester to the EVAP system.
- is located on the EVAP canister purge valve.

The EVAP Running Loss System Leak Test:

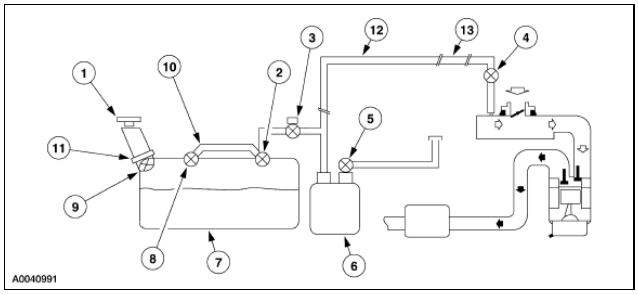
- utilizes intake manifold vacuum to test the EVAP system and involves several stages.

Evaporative Emissions

Special Tool(s)

 ST2116-A	Evaporative Emission System Leak Tester 310-F007 (134-00056) or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418 F224, New Generation STAR (NGS) Tester 418 F052, or equivalent scan tool

Evaporative Emission System



Item	Part Number	Description
1	9030	Fuel filler cap
2	9B190	Fuel vapor control valve
3	9C052	Fuel tank pressure sensor
4	9C915	Evaporative emission canister purge valve
5	9F945	Canister vent solenoid
6	9E857	Evaporative emission canister assembly
7	9002	Fuel tank
8	9B593	Fuel vapor vent valve
9	9039	Fuel filler pipe check valve
10	9E325	Fuel vapor jumper hose
11	9047	Fuel filler hose
12	9S284	Fuel/vapor line
13	9J280	Fuel/vapor line

Principles of Operation

Fuel Filler Cap

The fuel filler cap is used to prevent fuel spill and to close the EVAP system to the atmosphere.

Fuel Vapor Control Valve

The fuel vapor control valve is normally between the EVAP canister and the fuel vapor vent valve. Its function is to prevent the flow of liquid fuel into the EVAP canister or up to the canister purge valve during refueling, and to prevent the collection of liquid fuel in the fuel vapor hoses by overfilling the fuel tank. The fuel vapor control valve has a pressure relief feature which will vent excessive tank pressure to the atmosphere. The valve cannot be serviced separately; a new fuel tank must be installed.

Fuel Tank Pressure (FTP) Sensor

The fuel tank pressure sensor is used to measure the fuel tank pressure during the EVAP Running Loss System Leak Test. It is also used to control excessive fuel tank pressures by forcing the EVAP system to purge. The fuel tank pressure sensor is permanently mounted in the fuel vapor control valve tube assembly as it crosses over the fuel tank.

Evaporative Emission (EVAP) Canister Purge Valve

The EVAP canister purge valve is controlled by the powertrain control module (PCM). The EVAP canister purge valve controls the flow of fuel vapors from the EVAP canister to the engine intake manifold during various engine operating modes. The EVAP canister purge valve is normally closed.

Canister Vent Solenoid

During the Evaporative Emission Running Loss System Test Monitor, Evaporative Emissions Repair Verification Drive Cycle, and the Evaporative Emission System Leak Test, the canister vent solenoid is closed to allow either a vacuum to be drawn on the fuel tank or to hold a specified pressure in the system. The canister vent solenoid is normally open.

Evaporative Emission (EVAP) Canister

Fuel vapors from the fuel tank are stored in the EVAP canister assembly. When the engine is running, the vapors are purged from the EVAP canister for combustion.

Fuel Vapor Vent Valve (FVV) Assembly

The fuel vapor vent (FVV) valve assembly is mounted on the top of the fuel tank. It is used to control the flow of fuel vapors entering the EVAP system. The assembly also has a spring float, which prevents liquid fuel from entering the vapor delivery system under severe handling or vehicle rollover conditions. In the upright position, the open bottom of the float will lift and shut off the orifice. Under severe handling conditions, the spring will push the float closed when angles allow liquid fuel to reach the orifice. In a rollover condition, the weight of the open bottom float and spring pressure will close the orifice. The valve cannot be serviced separately; a new fuel tank must be installed.

Fuel Filler Pipe Check Valve

The fuel filler pipe check valve is an integral part of the fuel tank. It is intended to prevent liquid fuel from re-entering the fuel filler pipe from the fuel tank on refueling or rollover conditions.

Evaporative Emission System Monitor

When a fault occurs, the EVAP system monitor is reset to NO and a diagnostic trouble code (DTC) is set in the PCM memory. After the DTC is repaired, the vehicle drive cycle must be completed to reset the monitor in preparation for inspection and maintenance testing.

EVAP Running Loss System Leak Test

To start the testing, conditions of stable purging and vehicle speed must be satisfied. During the first stage, the canister vent solenoid is closed, while the EVAP canister purge valve remains open, applying and building vacuum in the system as indicated by the FTP sensor. This phase checks for major leaks in the EVAP system.

In the second stage, the EVAP canister purge valve closes and the system looks for minimal decay rate in the EVAP vacuum, indicating the absence of any small EVAP system leaks.

The last stage is entered only if stage two of the leak test has failed and checks whether the failed test was due to excess vapor generation. It monitors fuel vapor generation rate. Initially, the canister vent solenoid is opened to equalize EVAP system pressure to atmosphere. Then the canister vent solenoid is closed, allowing pressure to build if vapor generation is present in sufficient quantity. If the rate of generation is found to be too high, the EVAP running loss system leak test is aborted. If not, then a small leak is diagnosed.

On-Board Refueling Vapor Recovery (ORVR) Evaporative Emission (EVAP) System

The basic elements forming the ORVR system are as follows:

- The fuel filler pipe forms a seal to prevent vapors from escaping the fuel tank while liquid is entering the fuel tank. Liquid in the one inch diameter tube blocks vapors from rushing back up the fuel filler pipe.
- A fuel vapor control valve controls the flow of vapors out of the fuel tank. The valve closes when the liquid level reaches a height associated with fuel tank usable capacity. The valve accomplishes the following:
    - ♦ Limits the total amount of fuel that can be dispensed into the fuel tank.
    - ♦ Prevents liquid gasoline from exiting the fuel tank when submerged or when tipped well beyond a horizontal plane as part of the vehicle rollover protection in road accidents.
    - ♦ Minimizes vapor flow resistance during anticipated refueling conditions.
- Fuel vapor tubing connects the fuel vapor control valve to the EVAP canister. This routes the fuel tank vapors, displaced by the incoming liquid, to the EVAP canister.
- A check valve in the fuel filling system prevents liquid from rushing back up the fuel filler pipe during the liquid flow variations associated with the filler nozzle shut-off.

Between refueling events, the EVAP canister is purged with fresh air so that it may be used again to store vapors accumulated during engine soaks or subsequent refueling events. The vapors drawn off of the carbon in the EVAP canister are consumed by the engine.

Inspection and Verification

1. Verify the customer concern is with the evaporative emission (EVAP) system.

2. Visually inspect the following for obvious signs of mechanical damage.

Visual Inspection Chart

Mechanical
• Fuel filler cap • EVAP test port • EVAP canister assembly or canister vent solenoid

- EVAP lines or hoses
- Vacuum lines or hoses

3. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:

- check that the program card is correctly installed.
- check the connections to the vehicle.
- check the ignition switch position.

4. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.

5. Carry out the DATA LINK DIAGNOSTICS test. If the scan tool responds with:

- CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
- NO RESP/NOT EQUIP for PCM, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
- SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out the PCM KOEO self-test.

6. If the DTCs retrieved are related to the concern, go to the PCM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If the concern remains after the inspection, determine the symptom. GO to Symptom Chart .

PCM Diagnostics Trouble Code (DTC) Index

DTC	Description	Source	Action
P0442	Small leak detected in EVAP system (As small as 1.02 mm [0.040 inch])	PCM	Go To Pinpoint Test A .
P0455	Major leak or no flow detected	PCM	Go To Pinpoint Test B .
P0457	Check for missing or leaking fuel filler cap	PCM	Go To Pinpoint Test A .
P1443	Very small or no purge flow detected	PCM	Go To Pinpoint Test B .
P1450	Excessive vacuum detected in the fuel tank	PCM	Go To Pinpoint Test C .
	Any other PCM DTC	PCM	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart

SYMPTOM CHART

Pinpoint Tests

NOTE: Reinstall or install new evaporative emission hose clamps removed or damaged during testing procedures.

PINPOINT TEST A: DTC P0442 SMALL LEAK IN EVAP SYSTEM

PINPOINT TEST B: DTC P0455 MAJOR LEAK OR NO FLOW DETECTED OR DTC P1443 VERY SMALL OR NO PURGE FLOW DETECTED IN SYSTEM

PINPOINT TEST C: DTC P1450 EXCESSIVE VACUUM DETECTED IN THE FUEL TANK

PINPOINT TEST D: HISS WHEN OPENING FUEL CAP OR UNABLE TO REFUEL VEHICLE

PINPOINT TEST E: EXCESSIVE FUEL ODOR

Evaporative Emission System Leak Test

Special Tool(s)

 ST2116-A	Evaporative Emission System Leak Tester 310-F007 (134-00056) or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

⚠ CAUTION: The evaporative emission system must not be pressurized to more than 3.48 kPa (14 inches H_2O) or damage to the evaporative emission system may occur.

1. Connect the Evaporative Emission System Leak Tester to the evaporative emission test port.
2. Close the canister vent solenoid. For additional information, refer to Canister Vent Solenoid Closing Procedure in this section.
3. Pressurize the evaporative emission system to 3.48 kPa (14 inches/H_2O).
4. Monitor the system for two minutes. The system fails the Leak Test if the pressure falls below 2.0 kPa (8 inches/H_2O).
5. Repair any leaks as required.
6. Repeat the Leak Test until the system remains above 2.0 kPa (8 inches/H_2O) after the two-minute test period.

Canister Vent Solenoid Closing Procedure

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

⚠ **CAUTION: The canister vent solenoid must not be energized for more than nine minutes at one time. Once the canister vent solenoid is energized and de-energized, adequate time must be allowed for the component to cool adequately. Failure to allow the component to cool may create a false failure in the diagnostics, causing unnecessary repairs.**

1. Connect the scan tool and select the output test mode.
2. If PID monitors are not active, select PIDs.
3. Select the fuel tank pressure (FTP) and the volts (V) parameter identification (PID) for monitoring.
4. Select the ALL OFF mode.
5. Close the canister vent solenoid by pushing the START button on the scan tool.

Evaporative Emission Repair Verification Drive Cycle

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Drive Cycle Recommendations

NOTE: The following procedure is designed to execute and complete the evaporative emission repair verification drive cycle and to clear the Ford P1000, inspection and maintenance (I/M) readiness code. When the ambient air temperature is below 4.4°C (40°F) or above 37.8°C (100°F), or the altitude is above 2,438 meters (8,000 feet), the EVAP monitor will not run. If the P1000 must be cleared in these conditions, the powertrain control module (PCM) must detect them once (twice on some applications) before the EVAP monitor can be bypassed and the P1000 cleared. The EVAP bypassing procedure is described in the following drive cycle.

1. Most OBD II monitors will complete more readily using a steady foot driving style during cruise or acceleration modes. Operating the throttle in a smooth fashion will minimize the time necessary for monitor completion.

2. Fuel tank level should be between one-half and three-quarters full with three-quarters full being the most desirable.

3. The evaporative monitor can only operate during the first 30 minutes of engine operation. When executing the procedure for this monitor, stay in part throttle mode and drive in a smooth fashion to minimize fuel slosh.

Drive Cycle Preparation

NOTE: For best results, follow each of the following steps as accurately as possible.

4. **NOTE:** This step bypasses the engine soak timer and resets OBD II monitor status.

   Install the scan tool. Turn the key ON with the engine OFF. Cycle the key off, then on. Select the appropriate vehicle and engine qualifier. Clear all diagnostic trouble codes (DTCs) and carry out a PCM reset.

5. Begin to monitor the following PIDs: ECT, EVAPDC, FLI (if available) and TP MODE. Press Diagnostic Data Link, PCM, PID/Data monitor and record, press trigger to select each PID, then start.

6. Start the engine without returning the key to the OFF position.

Preparation for Monitor Entry

⚠ WARNING: Strict observance of posted speed limits and attention to driving conditions are mandatory when proceeding through the following drive cycle.

7. **NOTE:** This step allows engine warm-up and provides intake air temperature (IAT) input to the PCM.

   Idle the vehicle for 15 seconds. Drive at 64 km/h (40 mph) until the ECT is at least 76.7°C (170°F).

8. Is IAT above 4.4°C (40°F) and below 37.8°C (100°F)? If not, continue with the following steps but note that the EVAP Monitor Bypass portion of the drive cycle (Step 13) will be required to bypass the EVAP monitor and clear the P1000.

9. **NOTE:** This step executes the heated oxygen sensor (HO2S) monitor.

   Cruise at 64 km/h (40 mph) for 60 seconds.

10. **NOTE:** This executes the EVAP monitor if IAT is above 4.4°C (40°F) and below 37.8°C (100°F).

    NOTE: To initiate the monitor, TP MODE should equal PT, EVAPDC must be greater than 75%, and FLI must be between 15 and 85%.

    NOTE: Avoid sharp turns and hills.

    Cruise at 72 to 104 km/h (45 to 65 mph) for 10 minutes.

11. **NOTE:** This step executes the ISC portion of the Secondary Air/CCM.

    Bring the vehicle to a stop. Idle with the transmission in DRIVE (for automatic transmission) or NEUTRAL (for manual transmission) for two minutes.

Pending Code and EVAP Monitor Bypass Check

12. **NOTE:** This determines if a pending code is preventing the clearing of P1000.

    NOTE: If the EVAP monitor is not complete and IAT was below 4.4°C (40°F) or above 37.8°C (100°F) temperature range in Step 8, or the altitude is above 2,438 meters (8,000 feet), the EVAP Monitor Bypass (Step 13) must be carried out.

    Using the scan tool, check for pending codes. Conduct normal repair procedures for any pending code concerns. Rerun any incomplete monitor.

EVAP Monitor Bypass

13. **NOTE:** This allows the bypass counter to increment to two.

    NOTE: Do not repeat Step 4.

    Park the vehicle for a minimum of eight hours. Repeat Steps 5 through 12.

Evaporative Emission Canister

Material

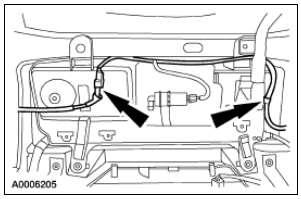
Item	Specification
MERPOL® or equivalent	ESE-M99B144-B

Removal and Installation

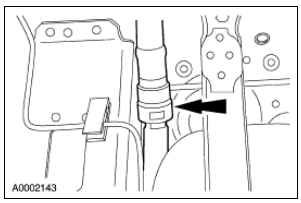
⚠ WARNING: The evaporative emission system contains fuel vapor and condensed fuel vapor. Although not present in large quantities, it still presents the danger of explosion or fire. Disconnect the battery ground cable from the battery to minimize the possibility of an electrical spark occurring, possibly causing a fire or explosion if fuel vapor or liquid fuel are present in the area. Failure to follow these instructions may result in personal injury.

⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

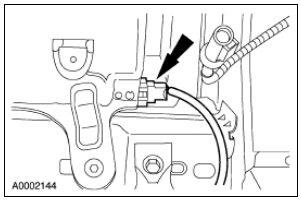
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Lower the rear subframe to access the evaporative emission canister assembly. For additional information, refer to Section 502-00 .
4. Disconnect the connectors.



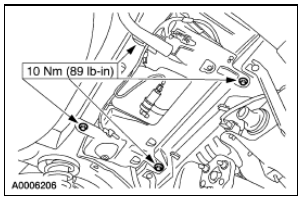
5. Disconnect the hose.



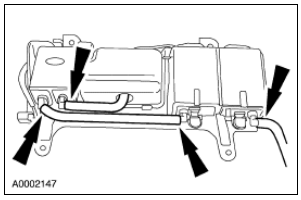
6. Disconnect the connector.



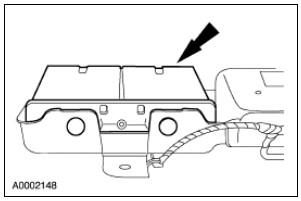
7. Remove the evaporative emission (EVAP) canister and bracket assembly (9E857).
   - Remove the four bolts.



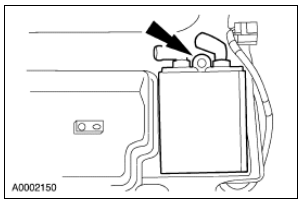
8. Disconnect the hoses.



9. Remove the EVAP canister.



10. Remove the EVAP canister.
    - Remove the rivet.



11. **NOTE:** The evaporative emission canister assembly must be leak-tested prior to installation on the vehicle.

    NOTE: Lubricate the O-ring seals with MERPOL®.

    To install, reverse the removal procedure.

    - Carry out a leak test. For additional information, refer to Evaporative Emission System Leak Test in this section.
    - Carry out the evaporative emission repair verification drive cycle. For additional information, refer to Evaporative Emission Repair Verification Drive Cycle in this section.

Evaporative Emission Canister Purge Valve

Material

Item	Specification
MERPOL® or equivalent	ESE-M99B144-B

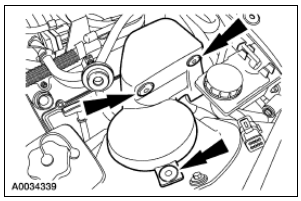
Removal and Installation

⚠ WARNING: The evaporative emission system contains fuel vapor and condensed fuel vapor. Although not present in large quantities, it still presents the danger of explosion or fire. Disconnect the battery ground cable from the battery to minimize the possibility of an electrical spark occurring, possibly causing a fire or explosion if fuel vapor or liquid fuel are present in the area. Failure to follow these instructions may result in personal injury.

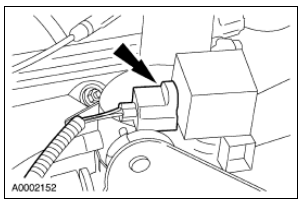
⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

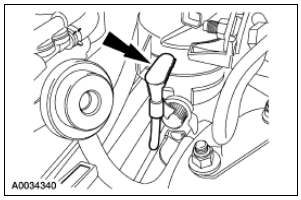
2. Remove the evaporative canister purge valve cover.



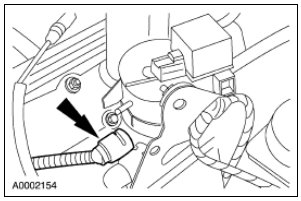
3. Disconnect the connector.



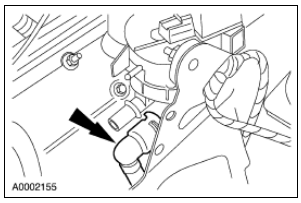
4. Disconnect the vacuum hose.



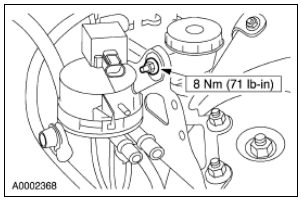
5. Disconnect the evaporative emission (EVAP) return tube.



6. Disconnect the EVAP canister purge outlet tube.



7. Remove the EVAP canister purge valve.



8. **NOTE:** Lubricate the O-ring seals with MERPOL®.

To install, reverse the removal procedure.

- Carry out a leak test. For additional information, refer to Evaporative Emission System Leak Test in this section.
- Carry out the evaporative emission repair verification drive cycle. For additional information, refer to Evaporative Emission Repair Verification Drive Cycle in this section.

Fuel Vapor Control Tube Assembly Valve

Material

Item	Specification
MERPOL®or equivalent	ESE-M99B144-B

Removal and Installation

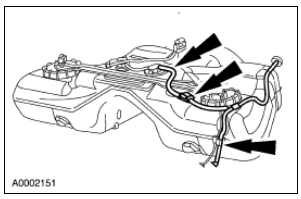
⚠ WARNING: The evaporative emission system contains fuel vapor and condensed fuel vapor. Although not present in large quantities, it still presents the danger of explosion or fire. Disconnect the battery ground cable from the battery to minimize the possibility of an electrical spark occurring, possibly causing a fire or explosion if fuel vapor or liquid fuel are present in the area. Failure to follow these instructions may result in personal injury.

⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in personal injury.

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Remove the fuel tank. For additional information, refer to Section 310-01 .

3. Disconnect and remove the fuel vapor control valve tube assembly.



4. **NOTE:** Lubricate the O-ring seals with MERPOL®.

   To install, reverse the removal procedure.

   - Carry out a leak test. For additional information, refer to Evaporative Emission System Leak Test in this section.
   - Carry out the evaporative emission repair verification drive cycle. For additional information, refer to Evaporative Emission Repair Verification Drive Cycle in this section.

Evaporative Emission Canister Vent Solenoid

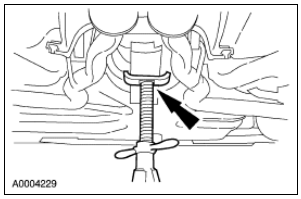
Material

Item	Specification
MERPOL®or equivalent	ESE-M99B144-B

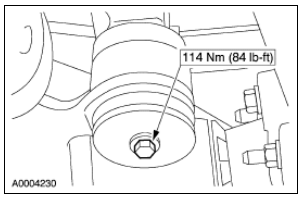
Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

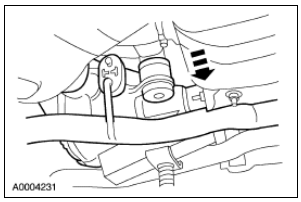
2. Position a jack stand under the differential.



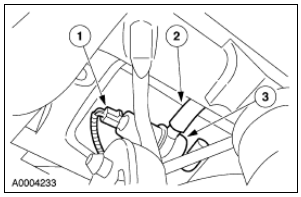
3. Remove the bolt.



4. Lower the differential to access the canister vent solenoid as necessary.



5. Remove the canister vent solenoid.
    1. Disconnect the connector.
    2. Disconnect the hose.
    3. Remove the canister vent solenoid.



6. **NOTE:** Lubricate the O-ring seals with MERPOL®.

To install, reverse the removal procedure.

- Carry out a leak test. For additional information, refer to Evaporative Emission System Leak Test in this section.
- Carry out the evaporative emission repair verification drive cycle. For additional information, refer to Evaporative Emission Repair Verification Drive Cycle in this section.

General Specifications

Item	Specification
High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA	ESE-M12A4-A
Super Premium SAE 5W-20 Motor Oil XO-5W20 QSP	WSS-M2C153 H

Torque Specifications

Description	Nm	lb-ft	lb-in
Camshaft position (CMP) sensor bolt	10		89
Crankshaft position (CKP) sensor bolt	10		89
Cross-vehicle support	20	15	
Cylinder head temperature (CHT) sensor	22	16	
Differential pressure feedback EGR (DPFE) nuts	6		53
Fuel pressure sensor bolts	4		35
Fuel pressure sensor shield bolts	10		89
Heated oxygen sensor (HO2S)	41	30	
Idle air control (IAC) valve bolts 3.0L	10		89
Intake manifold tuning valve (IMTV) bolts	10		89
Intake manifold tuning valve harness bracket nut	7		62
Idle air control (IAC) valve 3.9L	12	9	
Knock sensor (KS) bolt 3.9L	20	15	
Knock sensor (KS) bolt 3.0L	25	18	
Mass airflow (MAF) sensor plate nuts	5		44
Powertrain control module (PCM) bracket bolts	7		62
Powertrain control module (PCM) harness connector bolts	10		89
Power steering pressure (PSP) switch	17	13	
Throttle position (TP) sensor screws	3		27
Wiring harness bracket to cylinder head nuts	10		89

Electronic Engine Controls

The electronic engine controls consist of the following:

- powertrain control module (PCM)
- throttle position (TP) sensor
- idle air control (IAC) valve
- camshaft position (CMP) sensor
- crankshaft position (CKP) sensor
- mass air flow (MAF) sensor
- intake air temperature (IAT) sensor
- heated oxygen sensor (HO2S)
- catalyst monitor sensor
- knock sensor (KS) (12A699)
- cylinder head temperature (CHT) sensor
- power steering pressure (PSP) switch
- fuel pressure sensor
- vehicle speed sensor (VSS)
- intake manifold tuning valve (IMT)

The PCM needs the following inputs to calibrate the engine correctly:

- camshaft position
- engine rpm
- cylinder head temperature
- clutch pedal position
- amount of engine detonation
- mass air flow (MAF) sensor

The throttle position sensor:

- sends the PCM a signal indicating the throttle plate angle.
- is the main input to the PCM from the driver.

The idle air control valve:

- supplies air to the fuel rail for better atomization of fuel (3.9L only).
- controls bypass air around the throttle plate at low speeds.
- is controlled by the PCM.

The camshaft position sensor:

- sends the PCM a signal indicating camshaft position used for fuel synchronization and spark.

The power steering pressure switch:

- monitors the outlet pressure of the power steering pump and is calibrated to both an actuation and release pressure setting.
- increases the outlet pressure to match the severity of the turn maneuver.

The crankshaft position sensor:

- sends the PCM a signal indicating crankshaft position.
- is essential for calculating spark timing.

The mass air flow sensor:

- sends the PCM a signal indicating mass air flow rate of air entering the engine.

The intake air temperature sensor:

- sends the PCM a signal indicating the temperature of the air entering the engine.
- resistance decreases as temperature increases.

The heated oxygen sensors:

- monitor oxygen content before and after the exhaust flows through the catalytic converter.
- provide a voltage to the PCM used to calculate catalytic converter integrity.

The knock sensor:

- is located in the intake valley.
- sends a signal to the PCM indicating engine detonation. (If detonation is occurring, the PCM then changes spark timing.)

The cylinder head temperature sensor:

- is mounted into the wall of the cylinder head and is not connected to any coolant passages.
- sends a signal to the PCM indicating the cylinder head temperature.
- If the temperature exceeds approximately 121°C (250°F), the PCM disables half the fuel injectors at a time. The PCM will alternate which fuel injectors are disabled every 32 engine cycles. The cylinders that are not being fuel injected act as air pumps to aid in cooling the engine.
- If the temperature exceeds approximately 166°C (330°F), the PCM disables all of the fuel injectors until the engine temperature drops below approximately 154°C (310°F).
- The coolant temperature gauge pointer will read fully hot.
- The check gauge warning indicator will illuminate and DTCs are set.

The fuel pressure sensor:

- sends the PCM a signal indicating fuel pressure.
    - ♦ The PCM uses the fuel pressure sensor signal and the fuel temperature sensor signal to maintain the fuel liquid pressure in the fuel line which reduces the fuel vapor pressure in the fuel line.

The vehicle speed sensor:

- sends a frequency signal to the PCM.
    - ♦ The PCM uses the vehicle speed sensor signal to calculate vehicle speed and to determine shift scheduling and electronic pressure control.

The intake manifold tuning valve:

- connects the plenums to improve upper rpm power.

Electronic Engine Controls

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

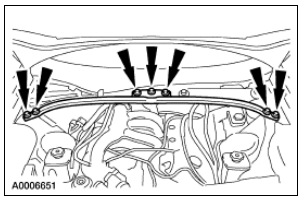
Intake Manifold Tuning (IMT) Valve 3.0L

Material

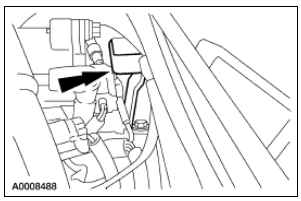
Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

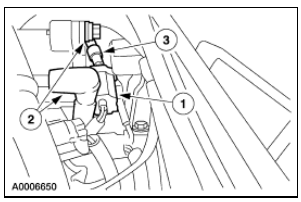
1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .
2. Remove the cowl vent screen. For additional information, refer to Section 501-00 .
3. Remove the bolts and the cross-vehicle support.



4. Remove the wiring harness bracket.



5. Remove the intake manifold tuning (IMT) valve.
    1. Disconnect the electrical connector.
    2. Remove the two bolts.
    3. Remove the IMT valve.



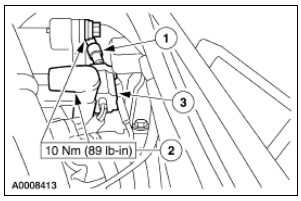
Installation

1. ⚠ **CAUTION: The IMT valve must be fully seated in the intake manifold prior to installing the bolts, or damage to the IMT valve may occur.**

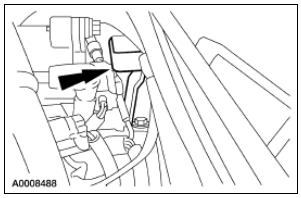
   Install the (IMT) valve.

    1. Coat the IMT valve with clean engine oil and install into the intake manifold.

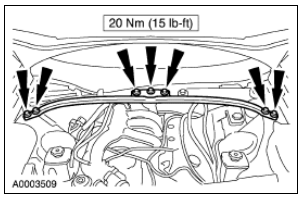
2. Install the two bolts.
3. Connect the electrical connector.



2. Install the wiring harness bracket.



3. Position the cross-vehicle support and install the bolts.



4. Install the cowl vent screen. For additional information, refer to Section 501-00 .

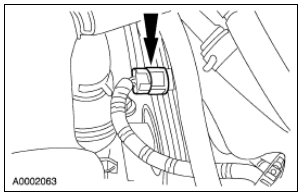
5. Connect the battery ground cable. For additional information, refer to Section 414-00 .

Camshaft Position (CMP) Sensor 3.0L

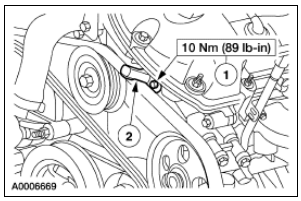
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .

2. Disconnect the camshaft position (CMP) sensor electrical connector.



3. Remove the CMP sensor.
    1. Remove the bolt from the CMP sensor.
    2. Remove the CMP sensor from the vehicle.



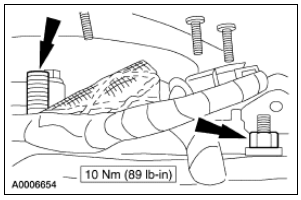
4. ⚠ **CAUTION: Do not overtighten the screw or damage to the CMP sensor may occur.**

    To install, reverse the removal procedure.

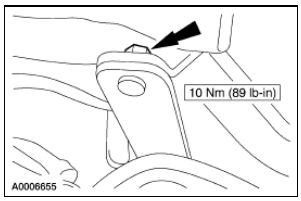
Camshaft Position (CMP) Sensor 3.9L

Removal and Installation

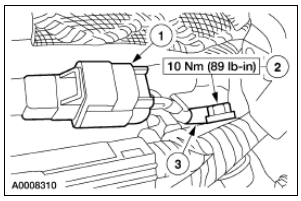
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the wiper motor. For additional information, refer to Section 501-16 .
3. Remove the harness bracket nut and stud from the rear of the LH cylinder head.



4. Remove the harness bracket nut and position the bracket away from the cylinder head.



5. Remove the camshaft position (CMP) sensor.
    1. Disconnect the electrical connector.
    2. Remove the bolt.
    3. Remove the CMP sensor.



6. ⚠ **CAUTION: Do not overtighten the screw or damage to the camshaft position sensor may occur.**

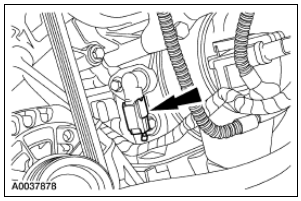
    NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

    To install, reverse the removal procedure.

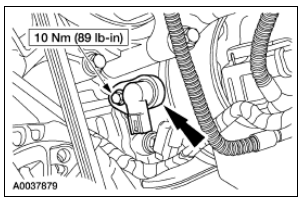
Crankshaft Position (CKP) Sensor 3.0L

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Disconnect the crankshaft position (CKP) sensor electrical connector.



4. Remove the CKP sensor bolt and the CKP sensor.

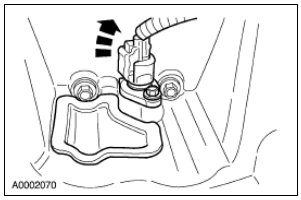


5. To install, reverse the removal procedure.

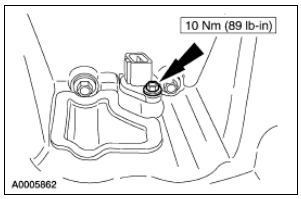
Crankshaft Position (CKP) Sensor 3.9L

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Disconnect the crankshaft position (CKP) sensor electrical connector.



4. Remove the bolt and the CKP sensor.

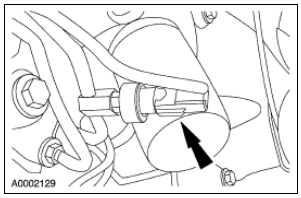


5. To install, reverse the removal procedure.

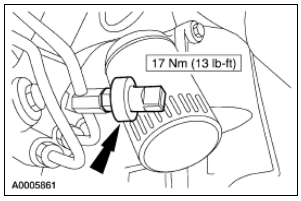
Power Steering Pressure (PSP) Switch 3.0L

Removal

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Disconnect the power steering pressure (PSP) switch electrical connector.



4. Remove the PSP switch.



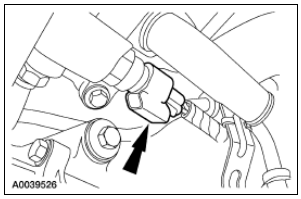
5. To install, reverse the removal procedure.

Power Steering Pressure (PSP) Switch 3.9L

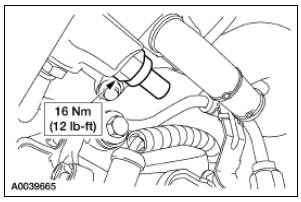
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Disconnect the power steering pressure (PSP) switch electrical connector.



3. Remove the PSP switch.



4. To install, reverse the removal procedure.

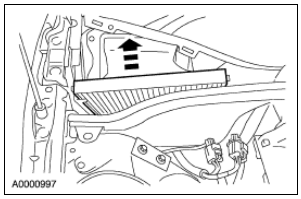
Powertrain Control Module (PCM)

Special Tool(s)

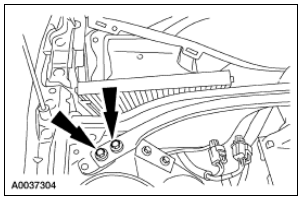
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool

Removal

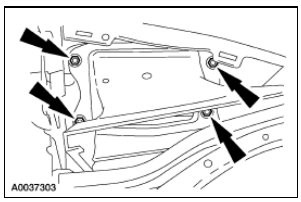
1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .
2. Remove the cowl vent screen. For additional information, refer to Section 501-00 .
3. Push on the RH corner of the filter to release the clip. Release the LH clip and remove the cabin air filter.



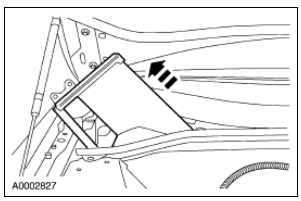
4. Remove the seven bolts and remove the cross-vehicle support.



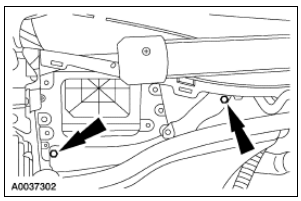
5. Remove the bolts.



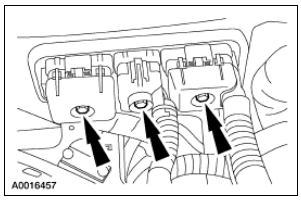
6. Remove the cabin air filter housing by lifting the outboard side then removing the housing.



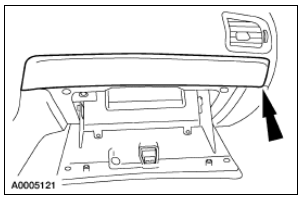
7. Remove the three bolts and remove the plenum panel.



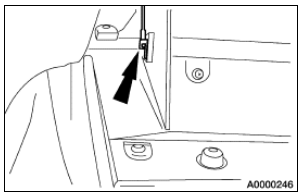
8. Loosen the bolts and disconnect the powertrain control module (PCM) harness connectors.



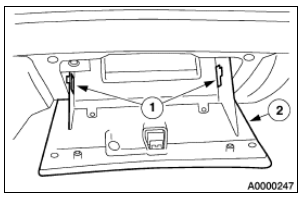
9. Remove the instrument panel finish panel.



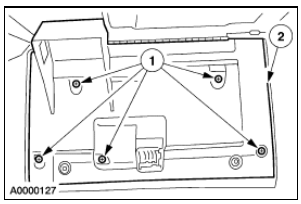
10. Release the assist cable from the glove compartment.



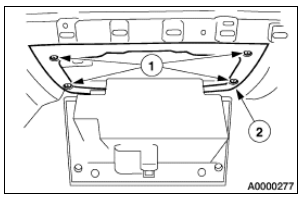
11. Lower the glove compartment.
    1. Release the tabs.
    2. Lower the glove compartment.



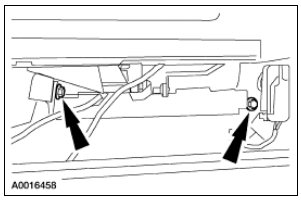
12. If equipped with a compact disc changer, remove the glove compartment inner panel.
    1. Remove the screw.
    2. Remove the panel.



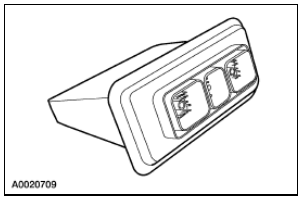
13. Remove the glove compartment instrument panel finish panel.
    1. Remove the screws.
    2. Remove the panel.



14. Remove the PCM bracket bolts and bracket.



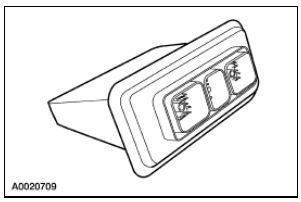
15. Remove the PCM.



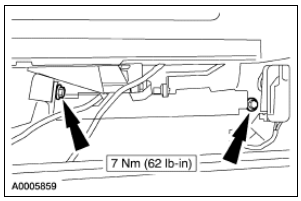
Installation

All vehicles

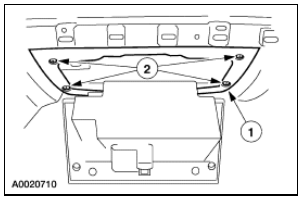
1. Install the PCM into the bracket.



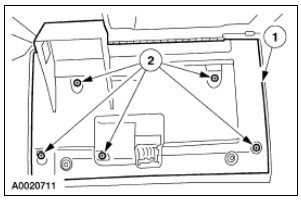
2. Install the PCM into the vehicle through the glove box and install the bolts.



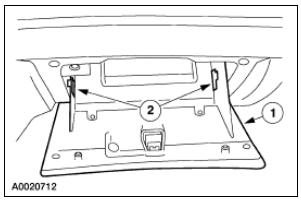
3. Install the glove compartment instrument panel finish panel.
    1. Position the panel.
    2. Install the screws.



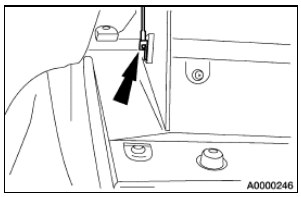
4. If equipped with a compact disc changer, install the glove compartment inner panel.
    1. Position the panel.
    2. Install the screws.



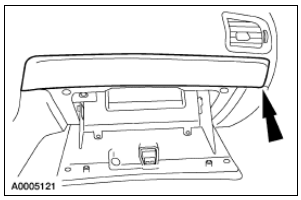
5. Raise the glove compartment.
    1. Raise the glove compartment.
    2. Position the stop tabs.



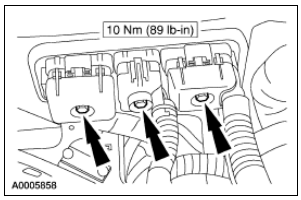
6. Connect the assist cable to the glove compartment.



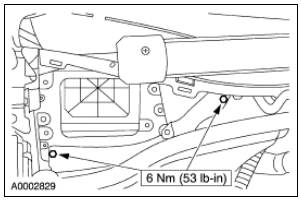
7. Install the instrument panel finish panel.



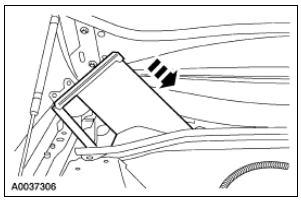
8. Connect the PCM harness connectors and tighten the bolts.



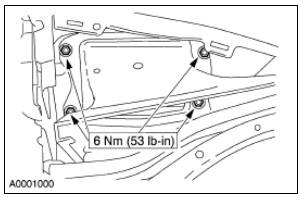
9. Install the plenum and the three bolts.



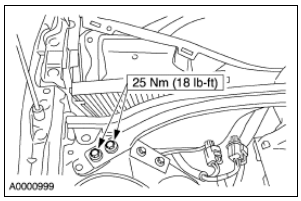
10. Install the cabin air filter housing.



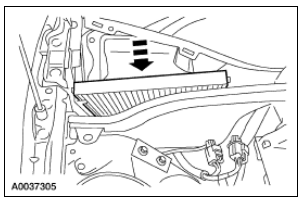
11. Install the cabin air filter housing bolts.



12. Install the cross-vehicle support and the seven retaining bolts.



13. Install the cabin air filter.



14. Install the cowl vent screen. For additional information, refer to Section 501-00 .

15. Connect the battery ground cable. For additional information, refer to Section 414-00 .

Vehicles with automatic transmission

16. Connect the scan tool.

17. Select ICM.

18. Select ENTER SECURITY ACCESS. Wait 10 minutes for security access to be granted.

19. Select PARAMETER RESET.

20. Disconnect the scan tool.
21. Place ignition key in the OFF position.
22. Place ignition key in the RUN position.
23. Remove the ignition key.

Vehicles with manual transmission

24. **NOTE:** The steering column lock (SCL) actuator will only allow communication with a tester after the SCL actuator has been activated. To activate the SCL actuator, open the driver door and **do not** put the key in the ignition (or alternatively, you can press one of the buttons on the key fob while there is no key in the ignition.) The SCL actuator will stay activated for 30 minutes after the driver door is opened (or a key fob button is pressed).

    Connect the scan tool.

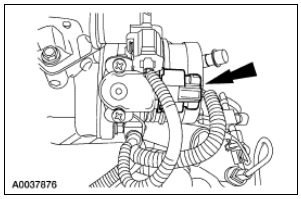
25. Place the ignition switch in the OFF position.
26. Select SCLM.
27. Select ENTER SECURITY ACCESS. Wait 8 minutes for security access to be granted.
28. Select PARAMETER RESET.
29. Place the ignition in the RUN position.
30. Select ICM.
31. Select ENTER SECURITY ACCESS. Wait 10 minutes for security access to be granted.
32. Select RESET SCLM PARAMETER.
33. Select PARAMETER RESET.
34. Disconnect the scan tool.
35. Place ignition key in the OFF position.
36. Place ignition key in the RUN position.
37. Remove the ignition key.

Throttle Position (TP) Sensor 3.0L

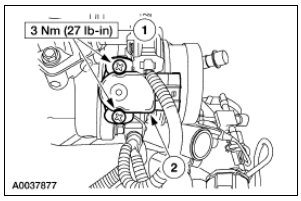
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .

2. Disconnect the throttle position (TP) sensor electrical connector.



3. Remove the TP sensor.
    1. Remove the screws from the TP sensor.
    2. Remove the TP sensor from the vehicle.



4. **NOTE:** The TP sensor cannot be adjusted. If necessary, a new sensor must be installed.

    To install, reverse the removal procedure.

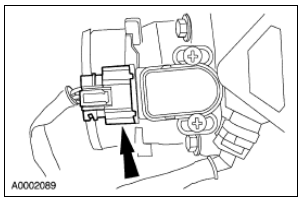
    - After installation, cycle the throttle lever to wide open throttle (WOT). It should return without interference.

Throttle Position (TP) Sensor 3.9L

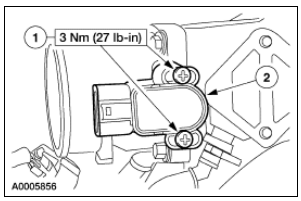
Removal and Installation

1. Remove the idler air control (IAC) valve. For additional information, refer to Idle Air Control (IAC) Valve 3.9L .

2. Disconnect the throttle position (TP) sensor electrical connector.



3. Remove the TP sensor.
    1. Remove the screws from the TP sensor.
    2. Remove the TP sensor from the vehicle.



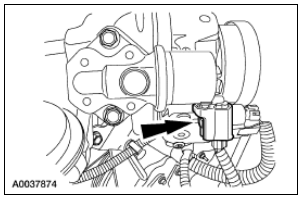
4. To install, reverse the removal procedure.
    - After installation, cycle the throttle lever to wide open throttle (WOT). It should return without interference.

Idle Air Control (IAC) Valve 3.0L

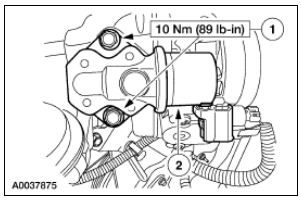
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .

2. Disconnect the electrical connector from the idle air control (IAC) valve.



3. Remove the IAC valve.
    1. Remove the bolts.
    2. Lift and remove the IAC valve from the vehicle and discard the gasket.



4. ⚠ **CAUTION: Do not use Carburetor Tune-up Cleaner D9AZ-19579-BA meeting Ford specifications ESR-M14P9-A or any other type of solvent as damage to the valve internal components may result.**

   NOTE: The engine control sensor wiring (12A581) cannot be cleaned. If necessary, new wiring must be installed.

   Clean the gasket mating surfaces.

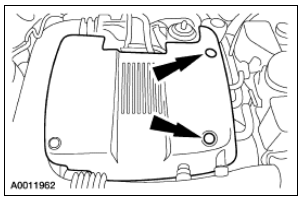
5. To install, reverse the removal procedure.
    - Install a new gasket.

Idle Air Control (IAC) Valve 3.9L

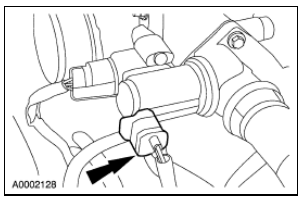
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Remove the engine appearance cover.
   - Remove the pin-type retainers.



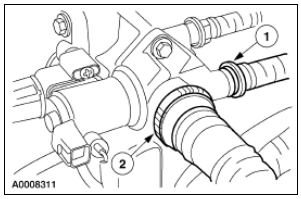
3. Disconnect the electrical connector from the idle air control (IAC) valve (9F715).



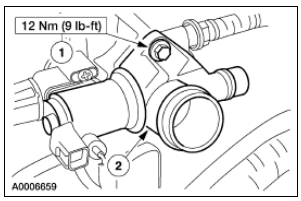
4. **⚠ CAUTION: In order to disconnect the Noma type hose fittings, squeeze the tabs and pull the hose straight back. Failure to squeeze tabs may result in fitting damage.**

   Disconnect the hoses.

   1. Disconnect the air assist hose.
   2. Disconnect the idle air bypass hose.



5. Remove the IAC valve.
   1. Remove the bolts from the IAC valve.
   2. Lift and remove the IAC valve from the vehicle and discard the gasket.



6. **⚠ CAUTION: Do not use Carburetor Tune-up Cleaner D9AZ-19579-BA meeting Ford specification ESR-M14P9-A or any other type of solvent as damage to the valve internal components may result.**

NOTE: The engine control sensor wiring cannot be cleaned. If necessary, new wiring must be installed.

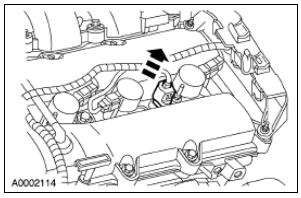
Clean the gasket mating surfaces.

7. To install, reverse the removal procedure.
    - Install a new gasket.

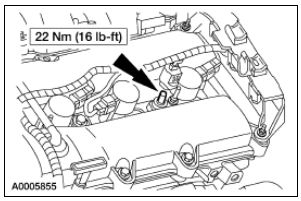
Cylinder Head Temperature (CHT) Sensor 3.0L

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .
2. Remove the engine appearance cover.
3. Disconnect the cylinder head temperature (CHT) sensor electrical connector.



4. Remove and discard the CHT sensor.



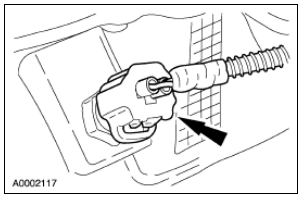
5. To install, reverse the removal procedure.

Cylinder Head Temperature (CHT) Sensor 3.9L

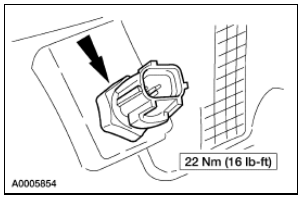
Removal and Installation

1. Remove the intake manifold. For additional information, refer to Section 303-01B .

2. Disconnect the cylinder head temperature (CHT) sensor electrical connector.



3. Remove and discard the CHT sensor.



4. **⚠ CAUTION: The tip of the CHT sensor must contact the cylinder head at the bottom of the hole. When removed, it will be slightly crushed. This is a normal condition.**

   NOTE: 3.9L CHT sensors are not to be reused. Always install a new sensor.

   To install, reverse the removal procedure.

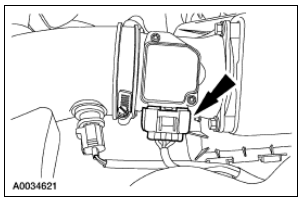
Mass Air Flow (MAF) Sensor

Removal and Installation

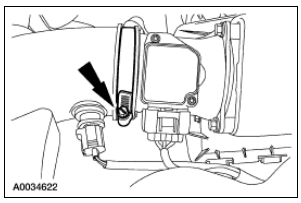
⚠ CAUTION: The mass airflow sensor hot wire sensing element and housing are calibrated as a unit and must be repaired as a complete assembly. Do not damage the sensing element (internal to housing) or possible failure of the MAF sensor may occur.

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

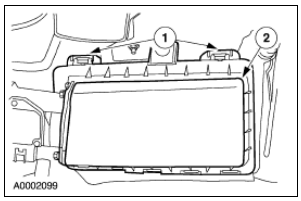
2. Disconnect the mass airflow (MAF) sensor electrical connector.



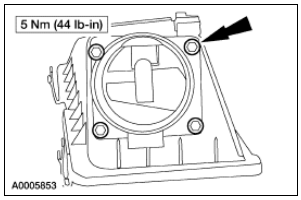
3. Loosen the screws on the air cleaner outlet tube clamp.



4. Remove the air cleaner housing cover.
    1. Release the cover clips.
    2. Remove the cover.



5. Remove the bolts and the MAF sensor.
    - Discard the gasket.



6. **NOTE:** A new gasket must be installed.

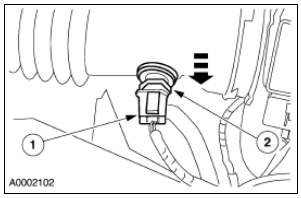
To install, reverse the removal procedure.

Intake Air Temperature (IAT) Sensor

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .

2. Remove the intake air temperature (IAT) sensor.
    1. Disconnect the IAT sensor electrical connector.
    2. Remove the IAT sensor.



3. Inspect the IAT sensor O-ring seal for damage or deterioration. Install a new O-ring seal as necessary.

4. To install, reverse the removal procedure.

Heated Oxygen Sensor (HO2S) 3.0L, 3.9L, Front

Special Tool(s)

 ST1448-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)

Material

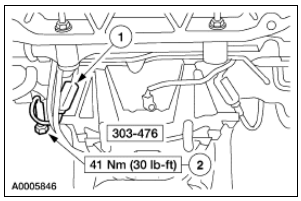
Item	Specification
High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA or equivalent	ESE-M12A4-A

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. **NOTE:** RH shown, LH similar.

   Remove the heated oxygen sensor (HO2S).

   1. Unclip and disconnect the electrical connector.
   2. Using the special tool, remove the HO2S.



4. To install, reverse the removal procedure.
   - Apply a light coat of anti-seize lubricant to the threads of the heated oxygen sensors.

Catalyst Monitor Sensor 3.0L (A/T), 3.9L

Special Tool(s)

 ST1448-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)

Material

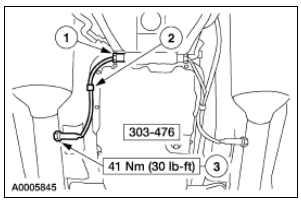
Item	Specification
High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA or equivalent	ESE-M12A4-A

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. **NOTE:** RH shown, LH similar.

   Remove the heated oxygen sensor (HO2S).

   1. Disconnect the electrical connector.
   2. Unclip the harness.
   3. Using the special tool, remove the sensor.



4. To install, reverse the removal procedure.
   - Apply a light coat of anti-seize lubricant to the threads of the heated oxygen sensors.

Catalyst Monitor Sensor 3.0L (M/T)

Special Tool(s)

 ST1448-A	Socket, Exhaust Gas Oxygen Sensor 303-476 (T94P-9472-A)

Material

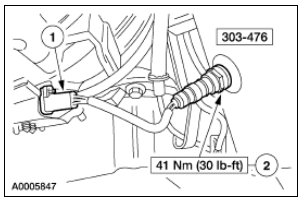
Item	Specification
High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA or equivalent	ESE-M12A4-A

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. **NOTE:** LH shown, RH similar.

   Remove the heated oxygen sensors (HO2S).

   1. Disconnect the electrical connector.
   2. Using the special tool, remove the HO2S.

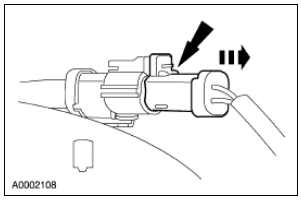


4. To install, reverse the removal procedure.
   - Apply a light coat of anti-seize lubricant to the threads of the heated oxygen sensors.

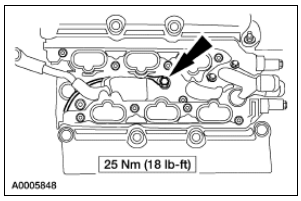
Knock Sensor (KS) 3.0L

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .
2. Remove the lower intake manifold. For additional information, refer to Section 303-01A .
3. Disconnect the knock sensor (KS) electrical connector.



4. Remove the bolt and the KS.

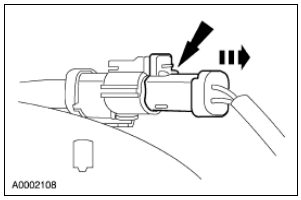


5. To install, reverse the removal procedure.

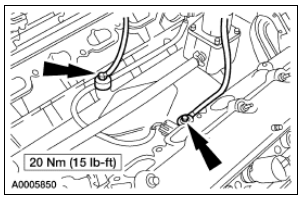
Knock Sensor (KS) 3.9L

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the intake manifold. For additional information, refer to Section 303-01B .
3. Disconnect the knock sensor (KS) electrical connectors.



4. Remove the bolts and the knock sensors.



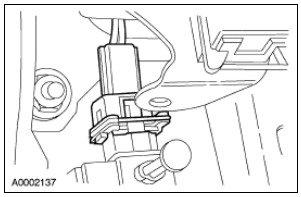
5. To install, reverse the removal procedure.

Clutch Pedal Position (CPP) Switch

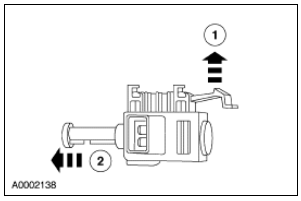
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .

2. Disconnect the clutch pedal position (CPP) switch electrical connector.



3. Remove the CPP switch.
    1. Lift the CPP switch retaining tag.
    2. Remove the CPP switch.



4. To install, reverse the removal procedure.

Fuel Pressure Sensor 3.0L

Material

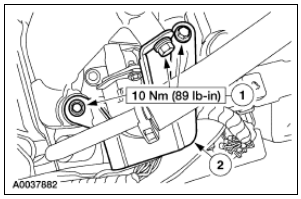
Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal and Installation

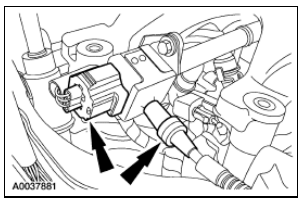
⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

⚠ WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components the fuel system pressure must be relieved. Failure to do so may result in personal injury.

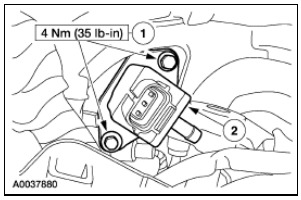
1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .
2. Relieve the fuel system pressure. For additional information, refer to Section 310-00 .
3. Remove the cowl vent screen. For additional information, refer to Section 501-00 .
4. Remove the fuel pressure sensor shield.
    1. Remove the bolts.
    2. Remove the shield.



5. Disconnect the fuel pressure sensor electrical connector and the fuel pressure sensor vacuum hose.



6. Remove the fuel pressure sensor.
    1. Remove the bolts.
    2. Remove the fuel pressure sensor.



7. ⚠ **WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.**

   NOTE: Lubricate the new seal and O-ring with clean engine oil.

   To install, reverse the removal procedure.

Fuel Pressure Sensor 3.9L

Material

Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal and Installation

⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

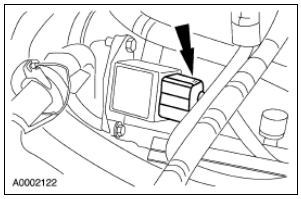
⚠ WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components the fuel system pressure must be relieved. Failure to do so may result in personal injury.

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven to relearn the strategy.

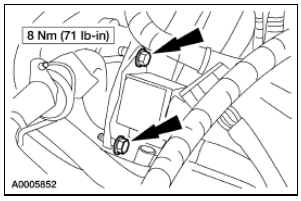
   Disconnect the battery ground cable. For additional information, refer Section 414-01 .

2. Relieve the fuel system pressure. For additional information, refer to Section 310-00 .

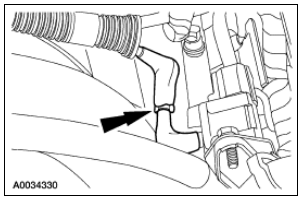
3. Disconnect the fuel pressure sensor electrical connector.



4. Remove the bolts.



5. Disconnect the fuel pressure sensor vacuum hose and remove the fuel pressure sensor.



6. ⚠ **WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.**

   NOTE: Lubricate the new seal and O-ring seals with clean engine oil.

   To install, reverse the removal procedure.

Fuel Temperature Sensor 3.0L

Material

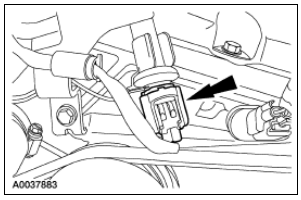
Item	Specification
Super Premium SAE 5W-20 XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal and Installation

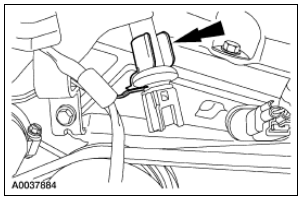
⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

⚠ WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before working on or disconnecting any of the fuel lines or fuel system components the fuel system pressure must be relieved. Failure to do so may result in personal injury.

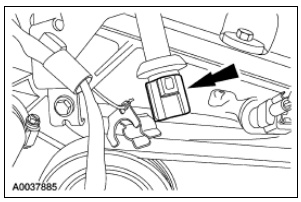
1. Disconnect the battery ground cable. For additional information, refer to Section 414-00 .
2. Relieve the fuel system pressure. For additional information, refer to Section 310-00 .
3. Disconnect the fuel temperature sensor electrical connector.



4. Remove the fuel temperature sensor retaining clip.



5. Remove the fuel temperature sensor. For additional information, refer to Section 310-00 .



6. **⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.**

NOTE: Lubricate the new seal and O-ring seals with clean engine oil.

To install, reverse the removal procedure.

General Specifications

Item	LH	RH	Split
Alignment Specifications Front			
Caster	8.10° ± 0.50°	8.10° ± 0.50°	0° ± 0.70°
Camber	-0.15° ± 0.50°	-0.15° ± 0.50°	0° ± 0.70°
Toe @ curb ride height (positive value is toe-in, negative value is toe-out)			+0.16° ± 0.25°
Alignment Specifications Rear			
Caster			
Camber	-1.0° ± 0.75°	-1.0° ± 0.75°	0° ± 0.75°
Toe @ curb ride height (positive value is toe-in, negative value is toe-out)	0.12° ± 0.25°	0.12° ± 0.25°	0.24° ± 0.25°

General Specifications

Item	Specification
Dogtracking maximum (centerline of front tires compared to centerline of rear tires)	12.7 mm (0.5 in.)
Clear Vision	
Clear vision (negative value is counterclockwise)	0° ± 3°
Ride Height	
Front	60.5 mm ± 8 mm (2.4 in. ± 0.3 in.)
Rear	25.8 mm ± 8 mm (1 in. ± 0.3 in.)
Ball Joint Radial Play	
Lower ball joint maximum	0.8 mm (1/32 in.)
Upper ball joint maximum	0.8 mm (1/32 in.)
Vehicle Lean (Side-to-Side Height Differences)	
Front wheel opening difference maximum	12 mm (0.5 in.)
Rear wheel opening difference maximum	

	12 mm (0.5 in.)
Vehicle Attitude (Front-to-Rear Height Difference)	
Maximum vehicle attitude = average front - average rear	14.5 mm (0.6 in.)

Torque Specifications

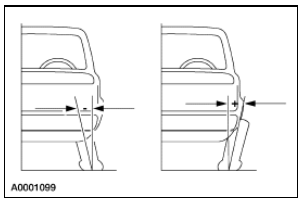
Description	Nm	lb-ft
Lower front suspension arm nuts	175	129
Rear toe link lock nuts	70	52
Steering column intermediate shaft pinch bolt	35	26
Steering gear lock nuts	103	76

Wheel Alignment Angles

Camber, caster and toe are adjustable on the front suspension system. Only the toe is adjustable on the rear suspension system. Camber and caster are adjusted by means of eccentric cams on the lower control arm mounting bolts. The front toe is adjusted by use of the front wheel spindle tie rod (3280). The rear toe is adjusted by the use of toe link assemblies connecting the knuckles to the rear sub-frame.

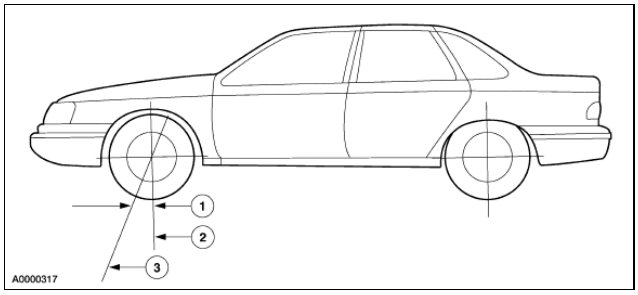
Camber

Negative and Positive Camber



Camber is the vertical tilt of the wheel when viewed from the front. Camber can be positive or negative and has a direct effect on tire wear.

Caster

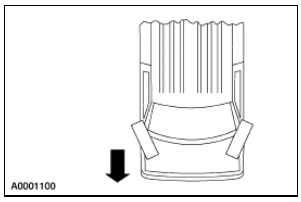


Item	Description
1	Positive caster
2	True vertical
3	Steering axis

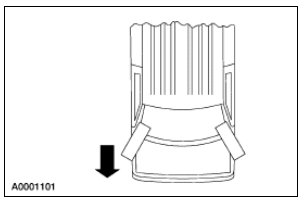
Caster is the deviation from vertical of an imaginary line drawn through the ball joints when viewed from the side. The caster specifications in this section will give the vehicle the best directional stability characteristics when loaded and driven. The caster setting is not related to tire wear.

Toe

Positive Toe (Toe-In)



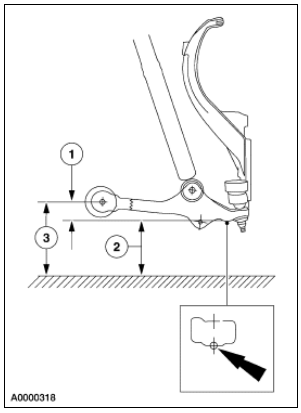
Negative Toe (Toe-Out)



The vehicle toe setting affects tire wear and directional stability.

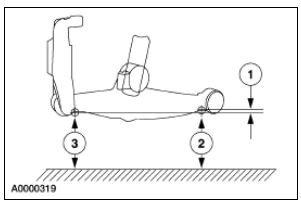
Ride Height

Front Ride Height Measurement



Item	Description
1	Ride height = B-A
2	Measurement A
3	Measurement B

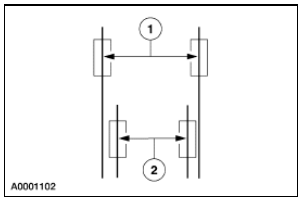
Rear Ride Height Measurement



Item	Description

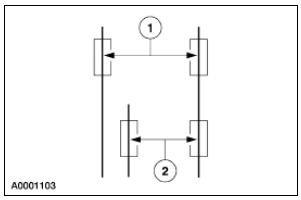
1	Ride height = A-B
2	Measurement A
3	Measurement B

Wheel Track



Item	Description
1	Front track
2	Rear track

Dogtracking



Item	Description
1	Front track
2	Rear track dogtracking

Dogtracking is the condition in which the independent rear suspension (IRS) system is not square to the chassis. Heavily crowned roads can give the illusion of dogtracking.

Wander

Wander is the tendency of the vehicle to require frequent, random left and right steering wheel (3600) corrections to maintain a straight path down a level road.

Shimmy

Shimmy, as observed by the driver, is large, consistent, rotational oscillations of the steering wheel resulting from large, side-to-side (lateral) tire/wheel movements.

Shimmy is usually experienced near 64 km/h (40 mph), and can begin or be amplified when the tire contacts pot holes or irregularities in the road surface.

Nibble

Sometimes confused with shimmy, nibble is a condition resulting from tire interaction with various road surfaces and observed by the driver as small rotational oscillations of the steering wheel.

Poor Returnability/Sticky Steering

Poor returnability and sticky steering is used to describe the poor return of the steering wheel to center after a turn or the steering correction is completed.

Drift/Pull

Pull is a tugging sensation, felt by the hands on the steering wheel, that must be overcome to keep the vehicle going straight.

Drift describes what a vehicle with this condition does with hands off the steering wheel.

- A vehicle-related drift/pull, on a flat road, will cause a consistent deviation from the straight-ahead path and require constant steering input in the opposite direction to counteract the effect.
- Drift/pull may be induced by conditions external to the vehicle (i.e., wind, road crown).

Poor Groove Feel

Poor groove feel is characterized by little or no buildup of turning effort felt in the steering wheel as the wheel is rocked slowly left and right within very small turns around center or straight-ahead (under 20 degrees of steering wheel turn). Efforts may be said to be "flat on center."

- Under 20 degrees of turn, most of the turning effort that builds up comes from the mesh of gear teeth in the steering gear (3504). In this range, the steering wheel is not yet turned enough to feel the effort from the self-aligning forces at the road wheel or tire patch.
- In the diagnosis of a roadability problem, it is important to understand the difference between wander and poor groove feel.

Suspension System

Inspection and Verification

1. Road test.
   - Verify the customer's concern by performing a road test on a smooth road. If any vibrations are apparent, refer to Section 100-04 .

2. Inspect tires.
   - Check the tire pressure with all normal loads in the vehicle and the tires cold. For additional information, refer to the vehicle certification (VC) label.
   - Verify that all tires are sized to specification.
   - Inspect the tires for incorrect wear and damage.

3. Inspect chassis and underbody.
   - Remove any excessive accumulation of mud, dirt or road deposits from the chassis and underbody.

4. Inspect for aftermarket equipment.
   - Check for aftermarket changes to the steering, suspension, wheel and tire components (such as competition, heavy duty, etc.). The specifications shown in this manual do not apply to vehicles equipped with aftermarket equipment.

Visual Inspection Chart

Mechanical
• Wheel bearing(s) • Loose or damaged front or rear suspension components • Loose, damaged or missing suspension fastener(s) • Incorrect spring usage • Damaged or sagging spring(s) • Damaged or leaking shock absorber(s) • Damaged or leaking strut(s) • Worn or damaged suspension bushing(s) • Loose, worn or damaged steering system components • Damaged axle components

5. If an obvious cause for an observed or reported condition is found, correct the cause (if possible) before proceeding to the next step.

6. If the fault is not visually evident, determine the symptom and proceed to the following symptom chart.

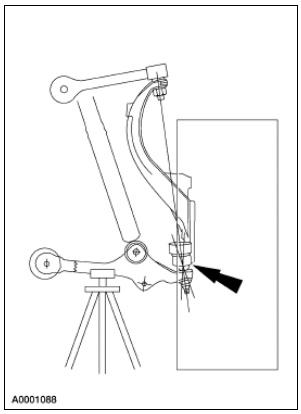
Symptom Chart

Component Tests

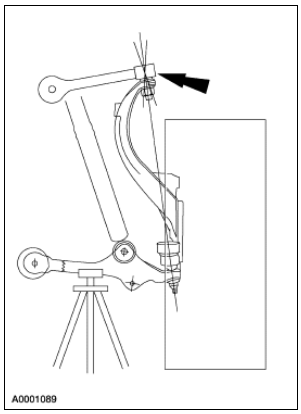
Ball Joint Inspection

NOTE: The front suspension is shown in the following procedures. The inspection of the rear suspension upper ball joint is similar.

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Prior to performing any inspection of the ball joints, inspect the front wheel bearings. For additional information, refer to Wheel Bearing Inspection Front and Rear .
3. Position a safety stand beneath the front suspension lower arm (3079) or rear suspension lower arm to be tested.



4. While an assistant pulls and pushes the top and bottom of the tire, observe the relative movement between the ball joint and the front suspension lower arm. Any movement at or exceeding the specification indicates a worn or damaged ball joint. Install a new spindle as necessary. For additional information, refer to Section 204-01 .



5. While an assistant pulls and pushes the top and bottom of the tire, observe the relative movement between the ball joint and the front suspension upper arm or rear suspension upper arm. Any movement at or exceeding the specification indicates a worn or damaged ball joint. Install a new front suspension upper arm or rear suspension upper arm as necessary. For additional information, refer to Section 204-01 or Section 204-02 .

6. Remove the safety stand.

7. Lower the vehicle.

Wheel Bearing Inspection Front and Rear

1. Raise the vehicle until the tire is off the floor. For additional information, refer to Section 100-02 .

2. **NOTE:** Make sure the wheel rotates freely and the brake pads are retracted sufficiently to allow movement of the tire and wheel assembly.

   Grasp each tire at the top and bottom and move the wheel inward and outward while lifting the weight of the tire off the wheel bearing.

3. If the tire and wheel (hub) is loose on the wheel spindle or does not rotate freely, install a new front wheel hub (1104) or rear hub (1109) as necessary. For additional information, refer to Section 204-01 or Section 204-02 .

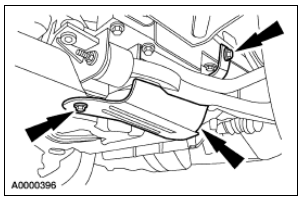
Camber and Caster Adjustment

NOTE: If the vehicle is equipped with hex head bolts in the lower control arm, new cam bolts and lock nuts must be installed before adjusting the cast and camber.

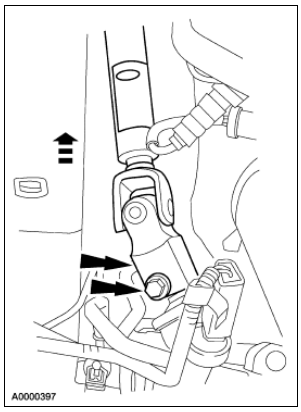
NOTE: The camber and caster adjustment for the LH side is shown. The procedure for adjusting the RH side is similar.

Vehicles without camber and caster adjustment cam bolts

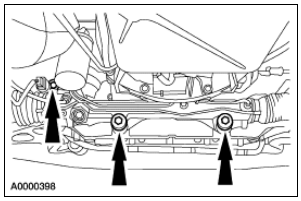
1. Remove two bolts, one pushpin and the splash shield.



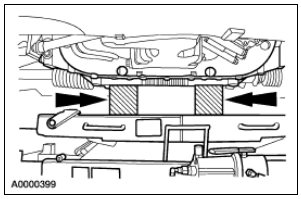
2. Remove and discard the pinch bolt. Disconnect the steering shaft.



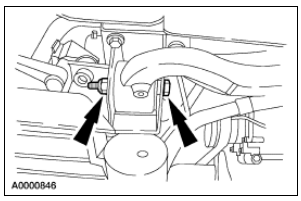
3. Remove three lock nuts and bolts. Discard the lock nuts.



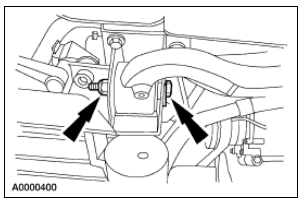
4. Raise and support the front end and the No. 2 crossmember.
   - Position two 4 in. x 4 in. pieces of wood between the No. 2 crossmember and the lifting device.



5. Remove and discard the front nut and bolt.

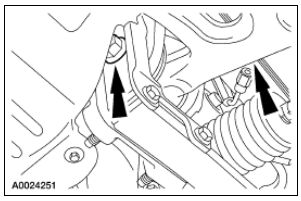


6. Install the caster adjustment cam bolt and a new lock nut.
   - The bolt must be installed from the rear as shown.
   - Install the bolt with the cam lobe down.
   - The cam must be seated between the cam guides on the No. 1 crossmember.

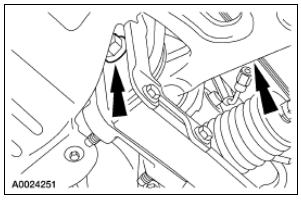


7. Position the steering gear (3504) aside.

8. Remove and discard the rear nut and bolt.

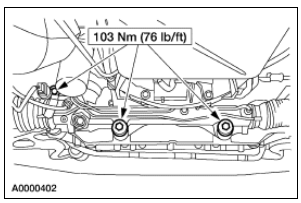


9. Loosely, install the camber adjustment cam bolt, a new lock nut and the I-brace bracket (if equipped).
   - The bolt must be installed from the rear as shown.
   - Install the bolt with the cam lobe down.
   - The cam must be seated in the groove in the No. 2 crossmember.

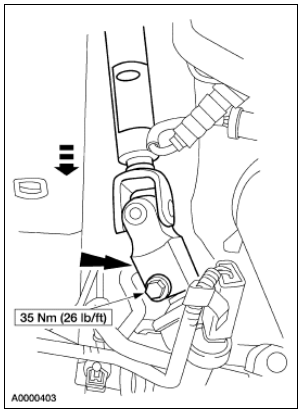


10. Lower the front end.

11. Install the steering gear, three bolts and new lock nuts.



12. Connect the steering shaft. Install a new pinch bolt.

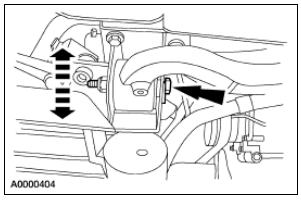


All vehicles

13. Measure the wheel alignment values. Follow the equipment manufacturer's instructions.

Vehicles requiring caster adjustment

14. Rotate the caster adjustment cam bolt (front) to adjust the caster.



15. Recheck the alignment settings. Follow the equipment manufacturer's instructions. Readjust as necessary.

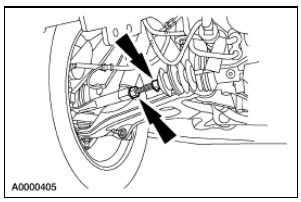
Vehicles requiring camber adjustment

16. **NOTE:** Adjustments to the camber impact the toe settings. Therefore, the camber and toe may need to be adjusted at the same time to get the correct values.

    NOTE: Both the LH and RH toe need to be adjusted when adjusting the camber.

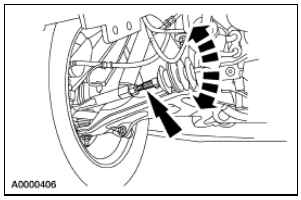
    Loosen the jam nut. Remove the clamp.

    - Clean and lubricate the jam nut and front wheel spindle tie-rod threads.



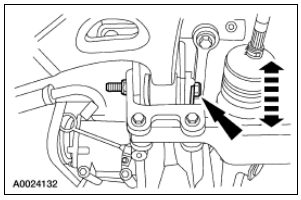
17. **NOTE:** Do not allow the steering gear bellows to twist when the front wheel spindle tie-rod is rotated.

    Rotate the front wheel spindle tie-rod to adjust the toe.



18. **NOTE:** To aid in accurate camber and toe measurements, support the front suspension lower arm by hand while rotating the camber adjustment cam bolt.

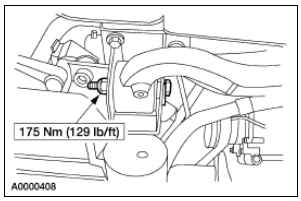
    Rotate the camber adjustment cam bolt (rear) to adjust the camber.



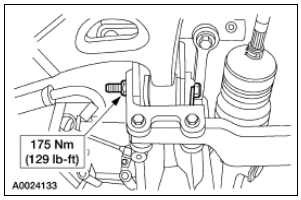
19. Repeat the above camber adjustment steps until the correct camber and toe measurements are achieved.

All vehicles

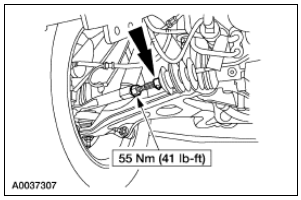
20. Tighten the nut.



21. Tighten the nut.

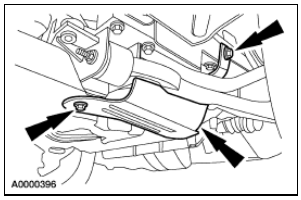


22. Tighten the nut. Install the clamp.



23. Recheck the alignment settings. Follow the equipment manufacturer's instructions. Readjust the caster as necessary.

24. Install the splash shield, one pushpin, and two bolts.


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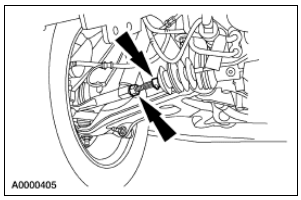
Front Toe Adjustment

1. Start the engine and center the steering wheel (3600).

2. Turn the engine off, and hold the steering wheel in the "straight forward" position by attaching a rigid link from the steering wheel to the brake pedal.

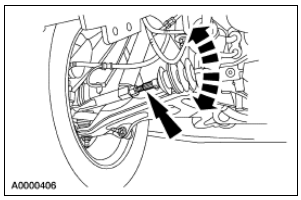
3. Check the toe settings. Follow the equipment manufacturer's instructions.

4. Loosen the nuts. Remove the clamps.
   - Clean and lubricate the nuts and front wheel spindle tie-rod threads.

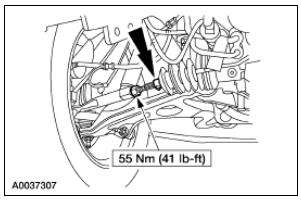


5. **NOTE:** Do not allow the steering gear bellows to twist when the front wheel spindle tie-rod (3280) is rotated.

   Rotate the front wheel spindle tie-rods.



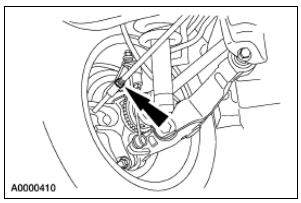
6. Tighten the nuts. Install the clamps.



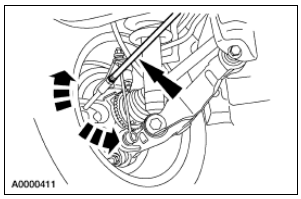
7. Recheck the toe settings. Follow the equipment manufacturer's instructions.

Rear Toe Adjustment

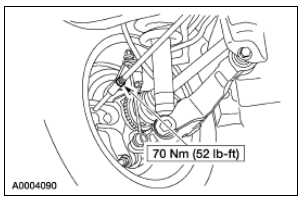
1. Loosen the nut.
   - Clean the nut and toe link threads.



2. Rotate the toe link to adjust the toe.



3. Tighten the nut.



4. Recheck the toe settings. Follow the equipment manufacturer's instructions.

General Specifications

Item	Specification
Motorcraft High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA (in Canada CXG-2-B)	ESE-M12A4-A
Rust Penetrant and Inhibitor F2AZ-19A501-A (in Canada CXC-51-A)	ESR-M99C56-A

Torque Specifications

Description	Nm	lb-ft	lb-in
Suspension upper arm-to-body nuts	48	35	
Suspension upper arm-to-knuckle nut	90	66	
Suspension lower arm-to-frame nuts	175	129	
Suspension lower arm-to-knuckle nut	150	111	
Stabilizer bar bracket bolts	75	55	
Stabilizer bar link nuts	55	41	
Tie-rod end-to-knuckle nut	80	59	
Hub and bearing-to-knuckle bolts	90	66	
Shock and spring assembly-to-lower control arm bolts and nuts	175	129	
Shock and spring assembly-to-body nuts	28	21	
Upper shock rod-to-upper mount nut	50	37	
Wheel nuts	135	100	
Heater water valve bracket	5		44
Engine control wiring bracket	5		44
Power steering gear nuts and bolts	103	76	

Front Suspension

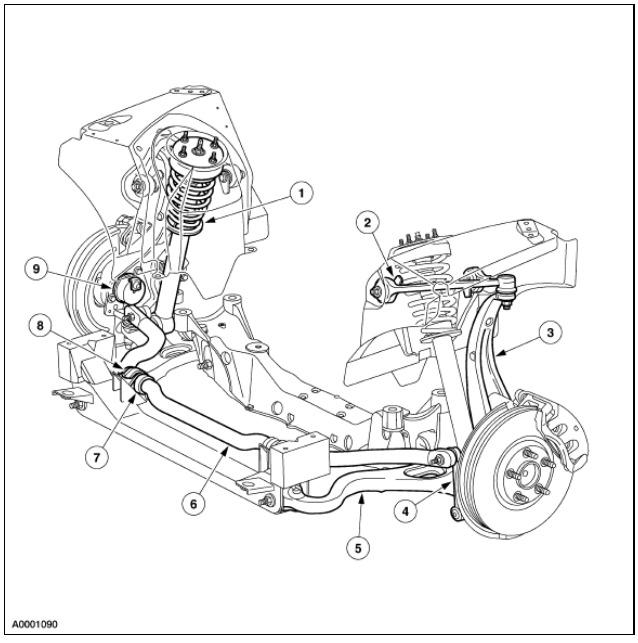
⚠ WARNING: All vehicles are equipped with gas-pressurized shock absorbers which will extend unassisted. Do not apply heat or flame to the shock absorbers during removal or component servicing. Failure to follow these instructions may result in personal injury.

⚠ CAUTION: All front suspension fasteners are important attaching parts because they can affect the performance of vital parts and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during assembly to make sure of correct retention of these parts. Never attempt to heat, quench or straighten any front suspension part. Install a new part.

The front suspension consists of the following components:

- upper suspension arm and bushing (3082)
- lower suspension arm and bushing (3078)
- shock absorber and spring assembly
- stabilizer bar (5482)
- stabilizer bar bushings (5493)
- stabilizer bar brackets (5486)
- stabilizer bar links (5K483)
- wheel knuckle (3K185)
- wheel hub and bearing (1104)

Front Suspension



Item	Part Number	Description
1		Shock absorber and spring assembly
2	3082	Upper arm and bushing
3	3K185	Wheel knuckle

4	5K483	Stabilizer bar link
5	3078	Lower arm and bushing
6	5482	Stabilizer bar
7	5493	Stabilizer bar bushing
8	5486	Stabilizer bar bracket
9	1104	Wheel hub and bearing

Front Suspension

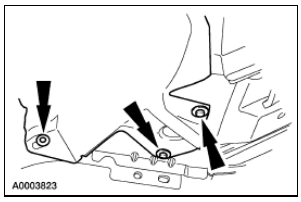
Refer to Section 204-00 .

Wheel Bearing and Hub

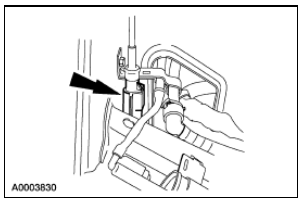
Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect the performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

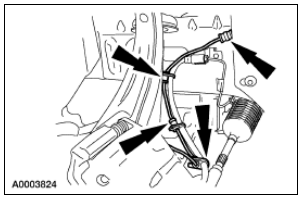
1. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .
2. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
3. Remove the brake disc. For additional information, refer to Section 206-03 .
4. Remove the pushpins.



5. Move the inner fender skirt aside and disconnect the anti-lock brake (ABS) sensor.



6. Detach the ABS sensor wire from the retainers.



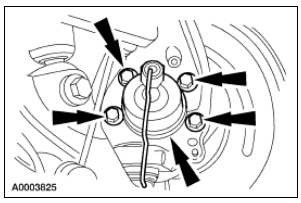
7. **⚠ CAUTION: The wheel hub and bearing (1104) is not pressed into the wheel knuckle (3K185). Do not use a slide hammer, or strike the back of the wheel hub and bearing to remove a stuck wheel hub and bearing. Damage to the bearing or the wheel hub will occur.**

   NOTE: If necessary, clean any rust or corrosion from the back of the wheel hub and bearing and lubricate the wheel hub and bearing with Rust Penetrant and Inhibitor D7AZ-19A501-AA or equivalent meeting Ford specification ESR-M99C56-A.

   NOTE: Do not remove the ABS sensor and wire from the hub and bearing unless a new ABS sensor and wire is being installed. If the ABS sensor is separated from the hub and bearing, make sure the

O-ring is in place and is not worn or damaged. Install a new O-ring if necessary.

Remove and discard the bolts. Remove the wheel hub and bearing.

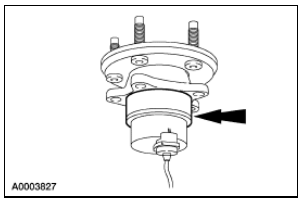


Installation

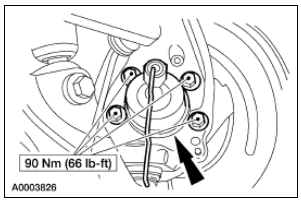
1. ⚠ **CAUTION: The knuckle bore must be clean to allow the wheel hub and bearing to be completely seated by hand. Do not press or draw the wheel hub and bearing into place.**

   Clean and inspect the knuckle bearing bore.

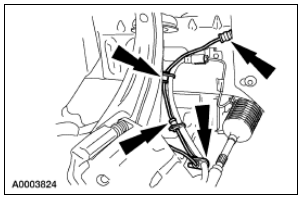
2. Lightly coat the surfaces of the bearing carrier and the wheel knuckle with Motorcraft High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA or equivalent meeting Ford specification ESE-M12A4-A.



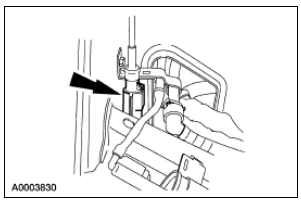
3. Install the wheel hub and bearing and new bolts.



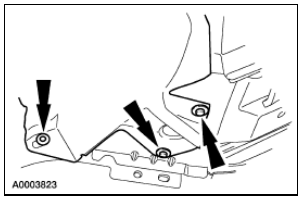
4. Route the ABS sensor wire and attach it to the retainers.



5. Move the inner fender skirt aside and connect the ABS sensor.



6. Position the inner fender skirt and install the pushpins.



7. Install the brake disc. For additional information, refer to Section 206-03 .

8. Install the wheel and tire assembly. For additional information, refer to Section 204-04 .

9. Lower the vehicle.

Wheel Studs

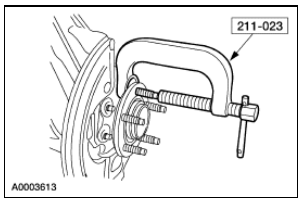
Special Tool(s)

 ST1494-A	C-Frame and Screw 211-023 (T74P-3044-A1)

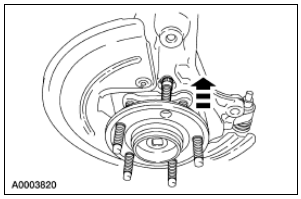
Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect the performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
2. Remove the front brake disc. For additional information, refer to Section 206-03 .
3. Using the special tool, press the stud from the flange.

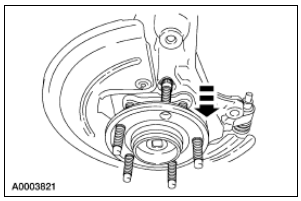


4. Line up the stud with the hole in the knuckle and remove the stud.



Installation

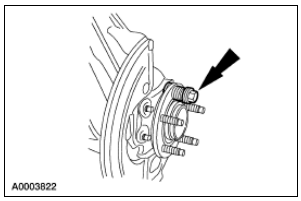
1. Insert the stud through the hole in the knuckle and into the flange, making sure the serrations on the stud line up with the serrations in the flange.



2. **⚠ CAUTION: Do not use power tools to install a wheel stud. The serrations in the flange can be stripped.**

NOTE: Do not use the wheel nuts that came with the vehicle.

Install washers and a wheel nut on the wheel stud and tighten the nut until the stud seats against the flange. Discard the nut after use.



3. Install the front brake disc. For additional information, refer to Section 206-03 .
4. Install the wheel and tire assembly. For additional information, refer to Section 204-04 .

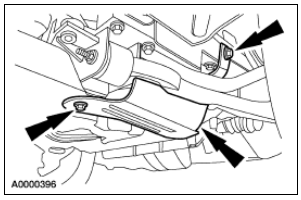
Lower Arm

Removal

⚠ **CAUTION: Suspension fasteners are critical parts because they affect the performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation is necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.**

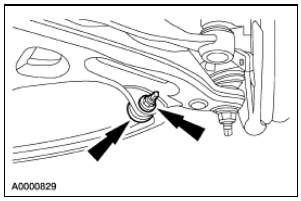
NOTE: New cam bolts and lock nuts must be installed whenever the lower control arm is removed.

1. Turn the ignition switch to the off, unlocked position.
2. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .
3. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
4. Remove two bolts, one pushpin and the splash shield.

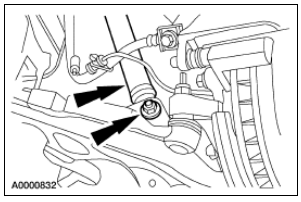


5. **NOTE:** To remove the nut, first loosen the nut, then use the hex holding feature to prevent the stabilizer bar link ball joint from turning while removing the nut.

   Remove and discard the nut. Disconnect the stabilizer bar link (5K483).



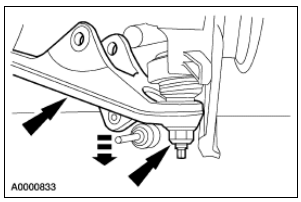
6. Remove and discard the nut and bolt. Disconnect the shock absorber and spring assembly.



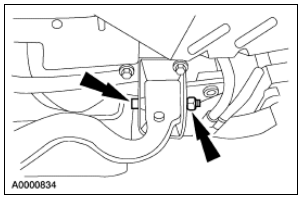
7. **NOTE:** To remove the nut, first loosen the nut, then use the hex holding feature to prevent the lower control arm ball joint from turning while removing the nut.

   NOTE: Make sure not to lose the tapered washer on the ball joint.

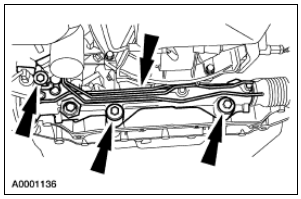
Remove and discard the nut. Separate the front suspension lower arm (3078) from the wheel knuckle.



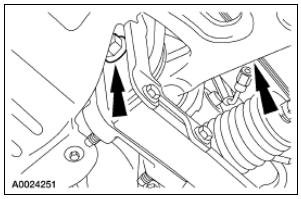
8. Remove and discard the front nut and bolt.



9. Position the power steering gear aside.
    - Remove two nuts and bolts. Discard the nuts.
    - Remove the nut and bolt. Discard the nut.
    - Position the power steering gear to access the lower control arm rear bolt.



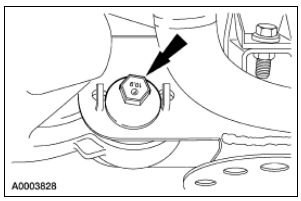
10. Remove and discard the rear nut and bolt. Remove the front suspension lower arm.



Installation

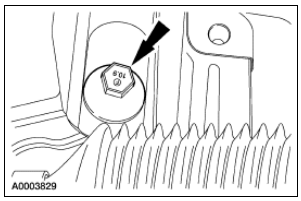
1. Position the front suspension lower arm.

2. Install a new caster adjustment cam bolt and a new nut.
    - The bolt must be installed from the rear, as shown.
    - Install the bolt with the cam lobe down.
    - The cam must be seated between the cam guides on the No. 1 crossmember.
    - The nut should only be snugged up at this time to allow for wheel alignment adjustment.



3. Install a new camber adjustment cam bolt and a new nut.

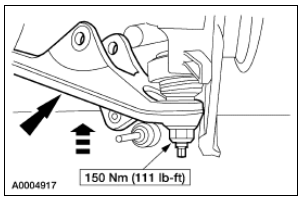
- The bolt must be installed from the rear as shown.
- Install the bolt with the cam lobe down.
- The cam must be seated in the groove in the No. 2 crossmember.
- The nut should only be snugged up at this time to allow for wheel alignment adjustment.



4. **NOTE:** Make sure the tapered washer is installed on the ball joint before connecting the lower control arm to the knuckle.

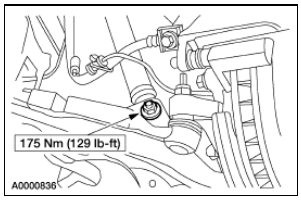
   NOTE: To install the nut, first install the nut until snug using the hex holding feature. Final tighten the nut using a socket and a torque wrench. If the ball stud turns during final tighten, use a crow's foot wrench while using the hex holding feature to final tighten the nut.

   Connect the lower control arm to the knuckle. Install a new nut.



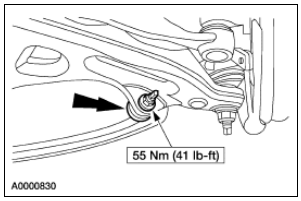
5. **NOTE:** Make sure the shock absorber lower bushing end caps are in place before installing the bolt and nut.

   Connect the shock absorber and spring assembly. Install a new bolt and nut.

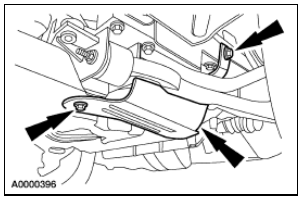


6. **NOTE:** To install the nut, first install the nut until snug using the hex head feature. Final tighten the nut using a socket and a torque wrench.

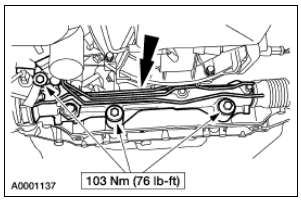
   Connect the stabilizer bar link. Install a new nut.



7. Install the splash shield, two bolts and one pushpin.



8. Attach the power steering gear.
    1. Remove the nut from the center bolt.
    2. Install two bolts and three new nuts.



9. Install the wheel and tire assembly. For additional information, refer to Section 204-04 .

10. Lower the vehicle.

11. Check the wheel alignment. Adjust as necessary. For additional information, refer to Section 204-00 .

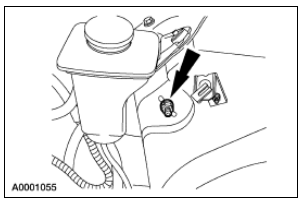
Upper Arm Left Side

Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect the performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

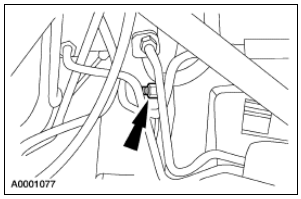
1. Remove the air cleaner. For additional information, refer to Section 303-12 .

2. Remove and discard the nut.



3. Remove the canister purge valve. For additional information, refer to Section 303-13 .

4. Remove and discard the nut.



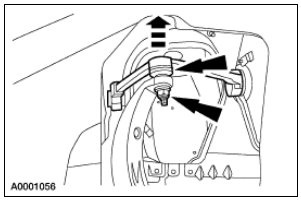
5. Remove the shock absorber and spring assembly. For additional information, refer to Shock Absorber and Spring Assembly in this section.

6. **NOTE:** Wire the top of the wheel knuckle to the body to prevent knuckle movement.

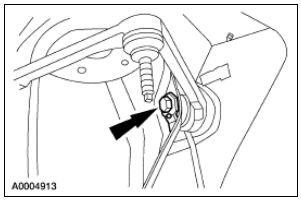
   NOTE: To remove the nut, first loosen the nut, then use the hex holding feature to prevent the upper control arm ball joint from turning while removing the nut.

   NOTE: Make sure not to lose the tapered washer on the ball joint.

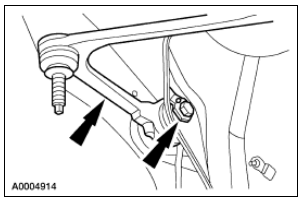
   Remove and discard the nut. Disconnect the suspension upper arm (3082) from the knuckle (3K185).



7. Remove and discard the bolt.

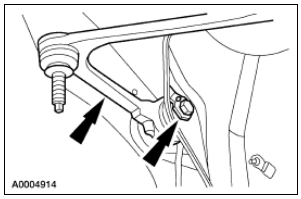


8. Remove the bolt and the suspension upper arm. Discard the bolt.

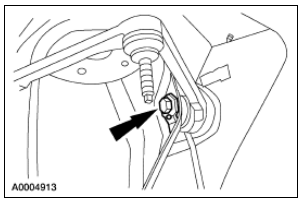


Installation

1. Position the suspension upper arm and install a new bolt.



2. Install a new bolt.

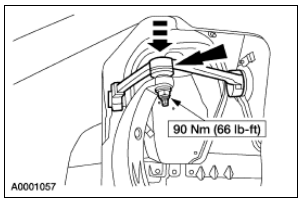


3. **NOTE:** Make sure the tapered washer is installed on the ball joint before connecting the upper control arm to the knuckle.

   NOTE: To install the nut, first install the nut until snug using the hex holding feature. Final tighten using a socket and a torque wrench.

   NOTE: Remove the wire holding the knuckle after tightening the nut.

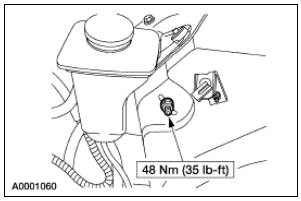
   Connect the suspension upper arm to the knuckle. Install a new nut.



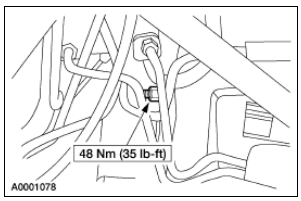
4. Install the shock absorber and spring assembly. For additional information, refer to Shock Absorber and Spring Assembly in this section.

5. ⚠ **CAUTION: The suspension lower arm-to-body nuts must be tightened with the suspension at curb height. Make sure the vehicle is completely lowered before tightening these nuts. Failure to do so can cause bushing failure, resulting in poor ride and handling.**

   Install a new nut.



6. Install a new nut.



7. Install the air cleaner. For additional information, refer to Section 303-12 .

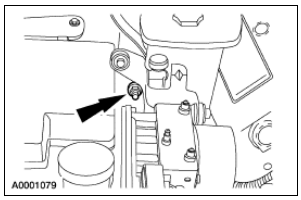
8. Install the canister purge valve. For additional information, refer to Section 303-13 .

Upper Arm Right Side

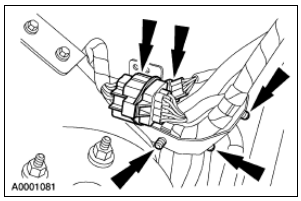
Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect the performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

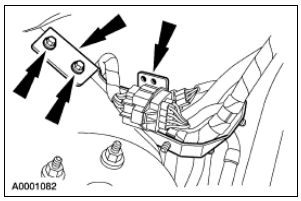
1. Remove and discard the nut.



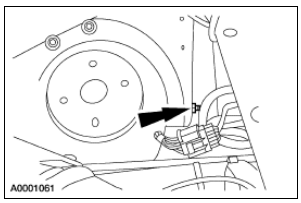
2. Detach the wires and electrical connectors from the bracket.



3. Remove three bolts and the bracket.



4. Remove and discard the nut.



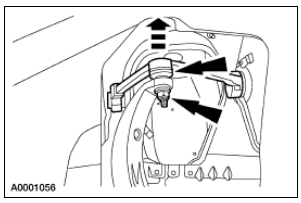
5. Remove the strut and spring assembly. For additional information, refer to Shock Absorber and Spring Assembly in this section.

6. **NOTE:** Wire the top of the wheel knuckle to the body to prevent knuckle movement.

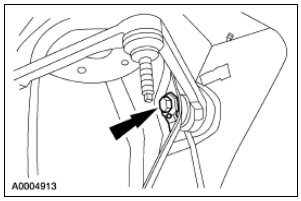
   NOTE: To remove the nut, first loosen the nut, then use the hex holding feature to prevent the ball joint from turning while removing the nut.

NOTE: Make sure not to lose the tapered washer on the ball joint.

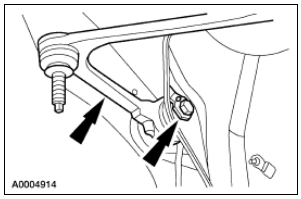
Remove and discard the nut. Disconnect the suspension upper arm (3082) from the knuckle (3K185).



7. Remove and discard the bolt.



8. Remove the bolt and the suspension upper arm. Discard the bolt.



Installation

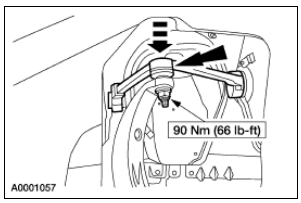
1. ⚠ **CAUTION: The suspension upper arm nuts must be tightened with the suspension at curb height. Make sure the vehicle is completely lowered before tightening these nuts. Failure to do so can cause bushing failure, resulting in poor ride and handling.**

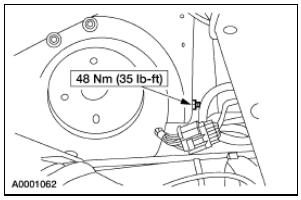
   NOTE: The suspension upper arm bolts and nuts are of a torque prevailing design. New bolts and nuts must be installed.

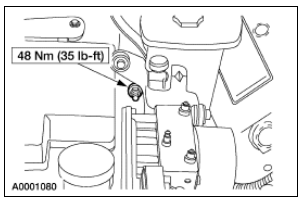
   NOTE: Make sure the tapered washer is installed on the ball joint before connecting the upper control arm to the knuckle.

   NOTE: To install the upper control arm ball joint nut, first install the nut until snug using the hex holding feature, then final tighten the nut using a socket and torque wrench.

   To install, reverse the removal procedure.




48 Nm (35 lb-ft)
A0001062

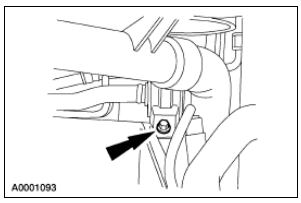

48 Nm (35 lb-ft)
A0001080

Stabilizer Bar

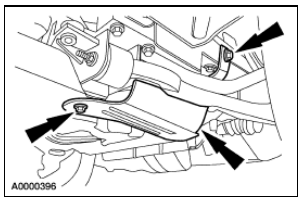
Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect the performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

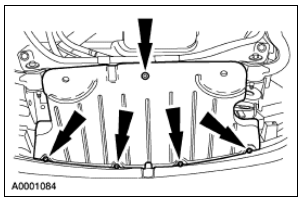
1. Remove the air cleaner. For additional information, refer to Section 303-12 .
2. Remove the bolt.



3. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .
4. Remove both wheel and tire assemblies. For additional information, refer to Section 204-04 .
5. Remove two pushpins, four bolts and both splash shields.

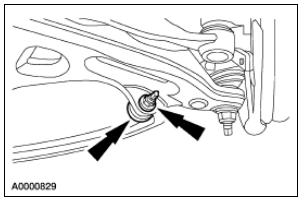


6. Remove the bolts and the shield.



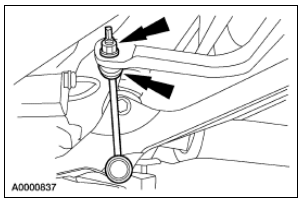
7. **NOTE:** To remove the nut, first loosen the nut, then use the hex holding feature to prevent the stabilizer bar link ball joint from turning while removing the nut.

   Remove the nut and disconnect the stabilizer bar link (5K483). Discard the nut.

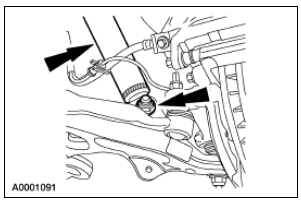


8. **NOTE:** To remove the nut, first loosen the nut, then use the hex holding feature to prevent the stabilizer bar link ball joint from turning while removing the nut.

   Remove the nut and stabilizer bar link. Discard the nut.



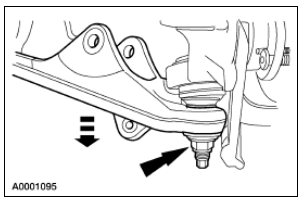
9. Remove and discard the nut and bolt. Disconnect the left shock absorber and spring assembly.



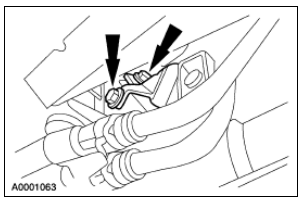
10. **NOTE:** To remove the nut, first loosen the nut, then use the hex holding feature to prevent the lower control arm ball joint from turning while removing the nut.

    NOTE: Make sure not to lose the tapered washer on the ball joint.

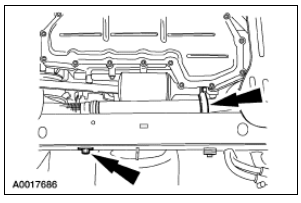
    Remove and discard the nut. Disconnect the left suspension lower arm and position the knuckle (3K185) out of the way.



11. Remove the bolts and position the heater water valve and bracket out of the way.

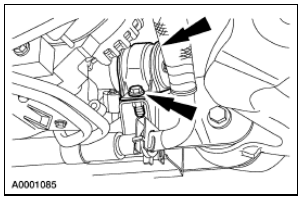


12. Remove the bolt and detach the A/C hose retainer. Position the A/C hose aside.

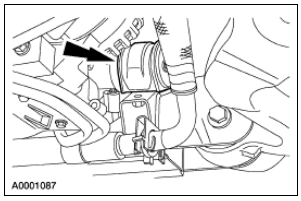


13. **NOTE:** To ease removal of the right front bolt, remove it first.

    Remove the bolts and the stabilizer bar brackets (5486).



14. Remove the stabilizer bar bushings (5493).



15. **NOTE:** Deflect the LH lower control arm downward to ease removal of the stabilizer bar.

    Carefully remove the stabilizer bar through the left wheel well.

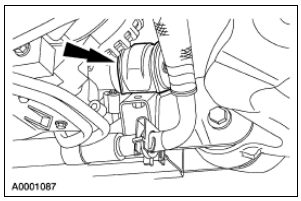
Installation

1. **NOTE:** Deflect the LH lower control arm downward to ease installation of the stabilizer bar.

   Carefully install the stabilizer bar through the left wheel well.

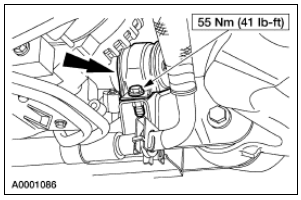
2. **NOTE:** If the stabilizer bar bushings are badly worn or have no grease, install new bushings. Do not grease the bushings.

   Install the stabilizer bar bushings.

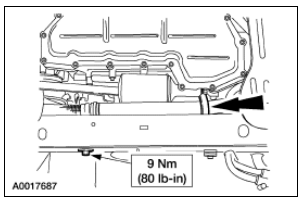


3. **NOTE:** To ease installation of the right front bolt, install the right rear bolt first.

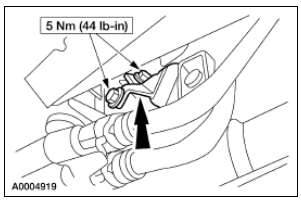
   Install the stabilizer bar brackets and the bolts.



4. Position the A/C hose, attach the retainer, and install the bolt.



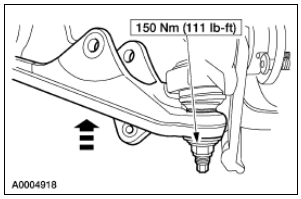
5. Position the heater water valve and bracket and install the bolts.



6. **NOTE:** Make sure the tapered washer is installed on the ball joint before connecting the lower control arm to the knuckle.

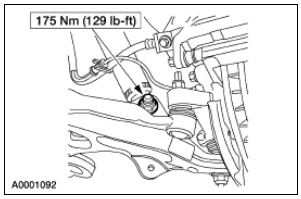
   NOTE: To install the nut, first install the nut until snug using the hex holding feature. Final tighten the nut using a socket and a torque wrench. If the ball stud turns during final tighten, use a crow's foot wrench to turn the nut while using the hex holding feature to final tighten the nut.

   Connect the suspension lower arm and install a new nut.



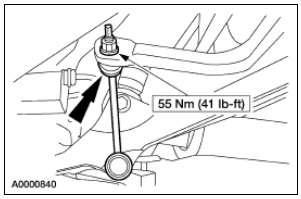
7. **NOTE:** Make sure the shock absorber lower bushing end caps are in place before installing the bolt and nut.

   Connect the shock absorber and spring assembly and install a new nut and bolt.



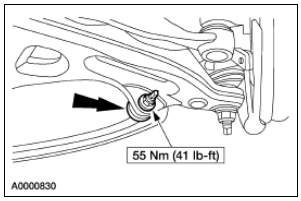
8. **NOTE:** To install the nut, first install the nut until snug using the hex holding feature. Final tighten the nut using a socket and a torque wrench.

   Position the stabilizer bar link and install a new nut.

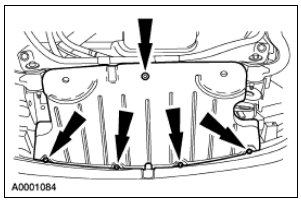


9. **NOTE:** To install the nut, first install the nut until snug using the hex holding feature. Final tighten the nut using a socket and a torque wrench.

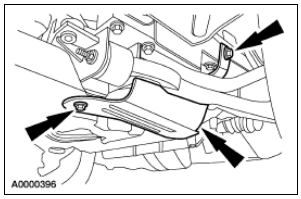
   Connect the stabilizer bar link and install a new nut.



10. Install the shield and the bolts.



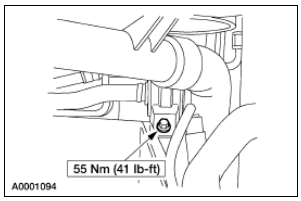
11. Install the shields, two pushpins and four bolts.



12. Install the wheel and tire assemblies. For additional information, refer to Section 204-04 .

13. Lower the vehicle.

14. Install the bolt.



15. Install the air cleaner. For additional information, refer to Section 303-12 .

Stabilizer Bar Link

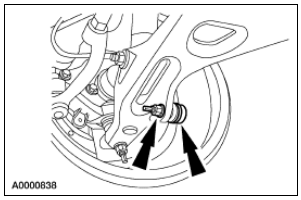
Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect the performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation is necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .

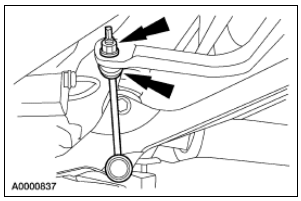
2. **NOTE:** To remove the nut, first loosen the nut, then use the hex holding feature to prevent the stabilizer bar link ball joint from turning while removing the nut.

   Remove the nut and disconnect the stabilizer bar link (5K483) from the suspension lower arm (3078).



3. **NOTE:** To remove the nut, first loosen the nut, then use the hex holding feature to prevent the stabilizer bar link ball joint from turning while removing the nut.

   Remove the nut and stabilizer bar link.

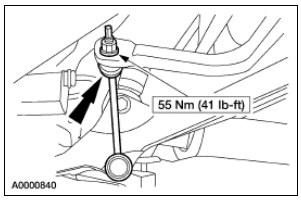


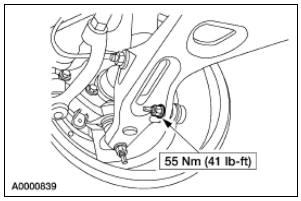
Installation

1. **NOTE:** The stabilizer bar nuts are of torque prevailing design. New nuts must be installed during assembly.

   NOTE: To install the nuts, first install the nuts until snug using the hex holding feature. Final tighten the nuts using a socket and a torque wrench.

   To install, reverse the removal procedure.




55 Nm (41 lb-ft)
A0000839

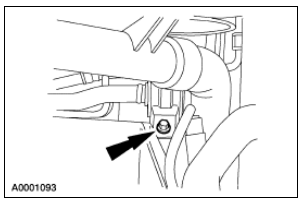
Stabilizer Bar Bushing

Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect the performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Remove the air cleaner. For additional information, refer to Section 303-12 .

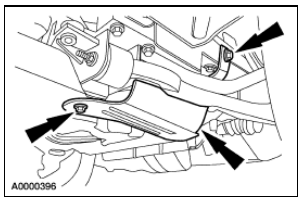
2. Remove the bolt.



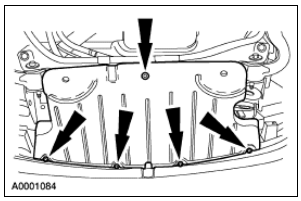
3. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .

4. Remove both wheel and tire assemblies. For additional information, refer to Section 204-04 .

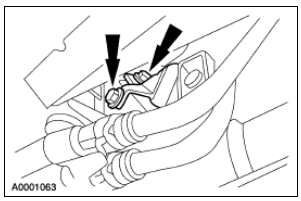
5. Remove two pushpins, four bolts and both splash shields.



6. Remove the bolts and the shield.

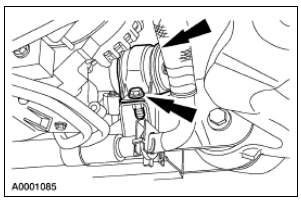


7. Remove the bolts and position the heater water valve and bracket out of the way.

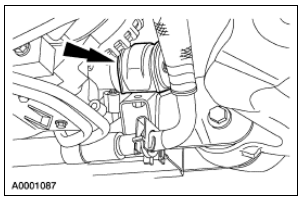


8. **NOTE:** To ease removal of the right front bolt, remove it first.

Remove the bolts and the stabilizer bar brackets (5486).



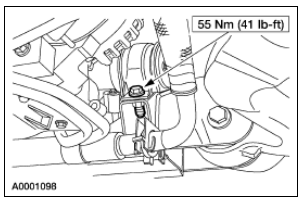
9. Remove the stabilizer bar bushings (5493).

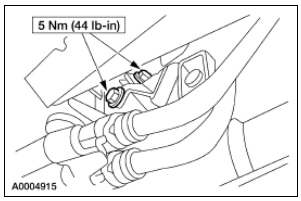


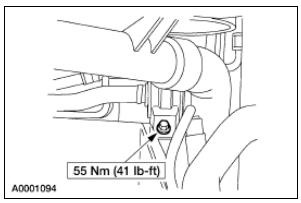
Installation

1. **NOTE:** If the stabilizer bar bushings are badly worn or have no grease, install new bushings. Do not grease the bushings.

   To install, reverse the removal procedure.







Wheel Knuckle

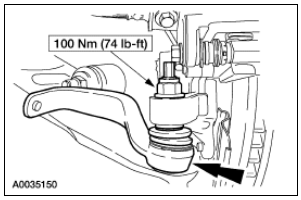
Removal and Installation

⚠ CAUTION: Suspension fasteners are critical parts because they affect the performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation becomes necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Remove the wheel bearing and hub (1104). For additional information, refer to Wheel Bearing and Hub in this section.

2. **NOTE:** The hex holding feature can be used to prevent turning of the stud while removing the nut.

   Remove the nut and disconnect the tie-rod end from the wheel knuckle (3K185). Discard the nut.

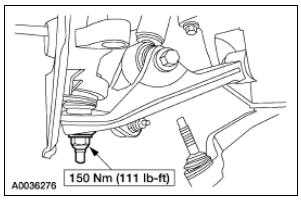


3. **⚠ CAUTION: Support the weight of the knuckle with a jack stand after disconnecting the lower control arm, or damage to the upper control arm can result.**

   NOTE: The hex holding feature can be used to prevent turning of the stud while removing the nut.

   NOTE: Make sure not to lose the tapered washer from the ball joint.

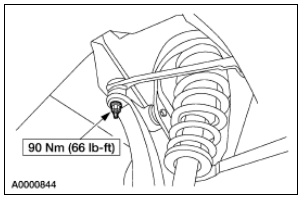
   Remove the nut and disconnect the suspension lower arm (3078) from the knuckle. Discard the nut.



4. **NOTE:** The hex holding feature can be used to prevent turning of the stud while removing the nut.

   NOTE: Make sure not to lose the tapered washer from the ball joint.

   Remove the nut and the knuckle. Discard the nut.



5. ⚠ **CAUTION: Support the weight of the knuckle with a jack stand while connecting the knuckle to the upper control arm or damage to the upper control arm can result.**

   NOTE: The upper arm-to-knuckle nut, lower arm-to-knuckle nut and the tie-rod-to-knuckle nut are of a torque prevailing design. New nuts must be installed.

   NOTE: Make sure the tapered washer is installed on the ball joints before connecting the upper and lower control arms to the knuckle.

   To install, reverse the removal procedure.

Shock Absorber and Spring Assembly

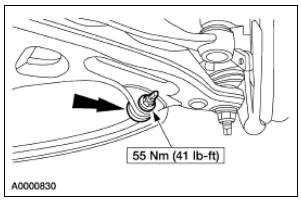
Removal and Installation

⚠ CAUTION: Suspension fasteners are critical parts because they affect the performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation is necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

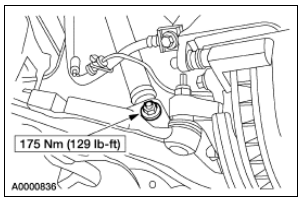
1. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

2. **NOTE:** The hex holding feature can be used to prevent turning of the stud while removing the nut.

   Remove the nut and disconnect the stabilizer bar link (5K483). Discard the nut.

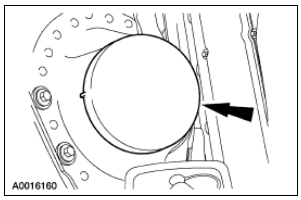


3. Remove the nut and bolt and disconnect the shock absorber and spring assembly.
   - Discard the nut and bolt.

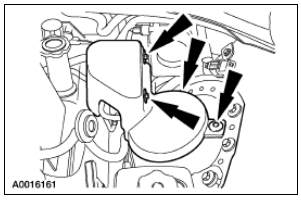


4. Partially lower the vehicle.

5. Remove the right upper shock mount cover.

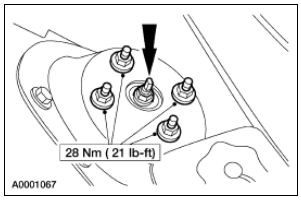


6. Remove the retainers and the left upper shock mount cover.



7. ⚠ **WARNING: Do not remove the center nut. This nut holds the upper spring mount in place and if this nut is removed the spring tension will be released. Failure to follow these instructions may result in personal injury.**

   Remove and discard four nuts. Remove the shock absorber and spring assembly.



8. ⚠ **CAUTION: Make sure the shock absorber lower bushing end caps are in place before installing the bolt and nut.**

   To install, reverse the removal procedure.

Shock Absorber and Spring Assembly

Disassembly

⚠ WARNING: All vehicles are equipped with gas pressurized shock absorbers which will extend unassisted. Do not apply heat or flame to the shock absorbers during removal or component servicing. Failure to follow these instructions can result in personal injury.

⚠ WARNING: The shock absorber and spring assembly is under extreme load. Do not attempt to disassemble the shock absorber and spring assembly without using a spring compressor. Failure to follow these instructions can result in personal injury.

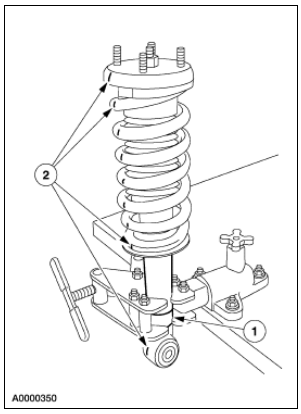
⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation is necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Remove the shock absorber and spring assembly. For additional information, refer to Shock Absorber and Spring Assembly in this section.

2. **⚠ CAUTION: Over tightening the vise can damage the shock absorber tube.**

   Mount and mark the shock absorber and spring assembly.

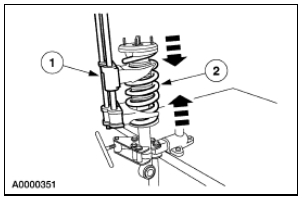
   1. Position the shock absorber and spring assembly in a suitable holding device.
   2. Mark the upper mount, spring and shock absorber for assembly reference.



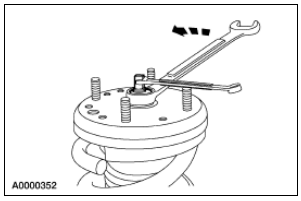
3. **NOTE:** If installing a new spring, make sure the part number is correct. Refer to the vehicle certification (VC) label for the correct spring code. Refer to Section 100-01 to convert the spring code to a part number.

   Compress the spring.

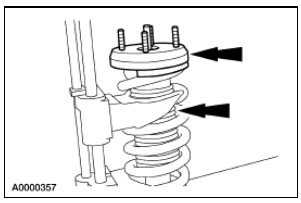
   1. Install an appropriate spring compressor.
   2. Compress the spring.



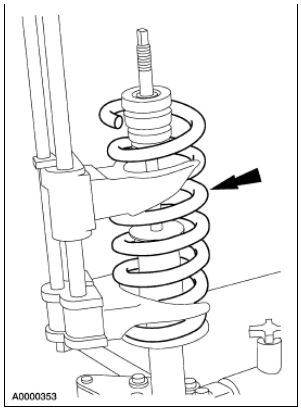
4. While holding the shock absorber rod, remove and discard the nut.



5. Remove the upper mount and dust boot as an assembly.



6. Carefully remove the spring and spring compressor.



Assembly

NOTE: If a new shock absorber, spring or upper mount is installed, the new part should be marked in the same place as the old part to make sure the assembly is correctly aligned.

1. Inspect the lower and upper spring seats for damage.

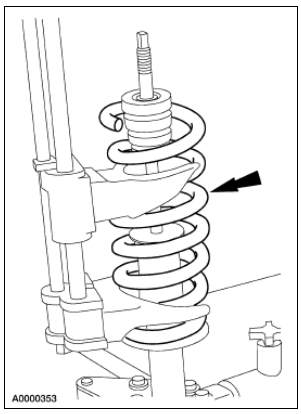
2. Inspect the spring insulator for wear or damage. Install a new upper mount if necessary.

3. **NOTE:** If installing a new spring make sure the part number is correct. Refer to the vehicle certification (VC) label for the correct spring code. Refer to Section 100-01 to convert the spring code to a part number.

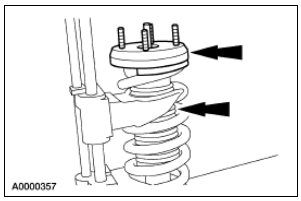
   Inspect the spring for nicked or scratched paint. If the paint is nicked or scratched, install a new spring.

4. If removed, place the shock absorber into the vise.

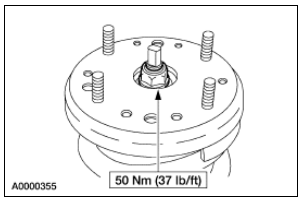
5. Position the shock and spring compressor onto the strut.



6. Position the upper mount and dust boot onto the spring. Make sure the marks made during disassembly, Step 2, are lined up.



7. Install a new nut.



8. Remove the spring compressor.

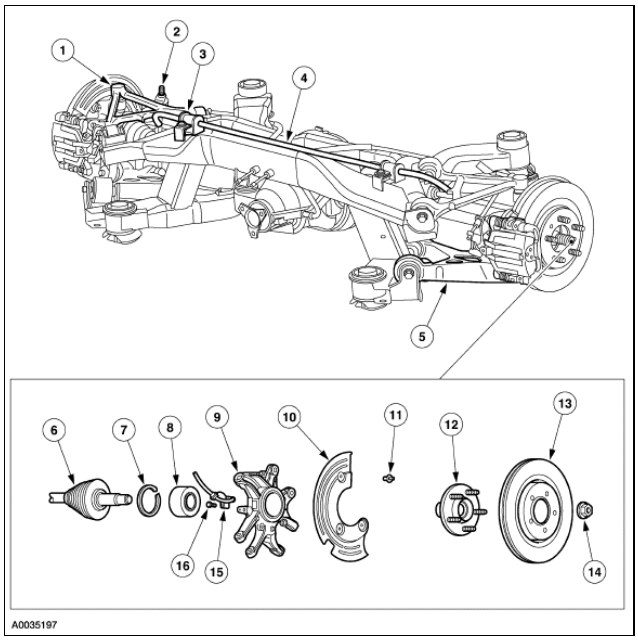
9. Install the shock absorber and spring assembly. For additional information, refer to Shock Absorber and Spring Assembly in this section.

Torque Specifications

Description	Nm	lb-ft	lb-in
Subframe-to-body bolts	103	76	
Upper arm and bushing-to-subframe pivot bolt nuts	90	66	
Upper ball joint nut	90	66	
Lower arm and bushing-to-subframe pivot bolt and nut	150	111	
Lower arm and bushing-to-knuckle pivot bolt nut	150	111	
Toe link nut (outer)	55	41	
Toe link nut (inner)	70	52	
Stabilizer bar link nuts	48	35	
Stabilizer bar bracket bolts	55	41	
Anti-lock brake sensor bolt	10		89
Shock absorber and spring assembly-to-lower arm and bushing bolt	133	98	
Upper shock absorber rod-to-upper shock absorber mount nut	50	37	
Upper shock absorber mount-to-body nuts	28	21	
Axle shaft retaining nut	410	302	

Rear Suspension

Rear Suspension Components



Item	Part Number	Description
1	5500	Upper arm
2	5C488	Stabilizer bar link
3	5486	Stabilizer bar retaining bracket
4	5A772	Stabilizer bar
5		Lower arm
6		Axle shaft
7	W701904-S309M	Snap ring
8	1244	Wheel hub bearing
9		Knuckle
10	2C028	Rear brake disc shield
11	W701950-S100	Rivet
12	1109	Hub
13	2C026	Rear brake disc
14	4B477	Hub retainer
15	2C190	ABS sensor
16	W500014-S426	Screw

The independent rear suspension consists of the following components:

- upper arms (5500)
- lower arms
- shock absorber and spring assemblies
- adjustable toe links
- stabilizer bar (5A772)

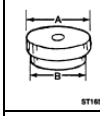
- rear wheel knuckles
- hubs (1109)
- wheel bearings (1244)

Rear Suspension

Refer to Section 204-00 .

Wheel Hub

Special Tool(s)

 ST1650-A	Step Plate Adapter Set 205-DS011 (D80L-630-A) or equivalent
 ST1310-A	Remover, Bearing 205-055 (T71P-4621-B)

Removal

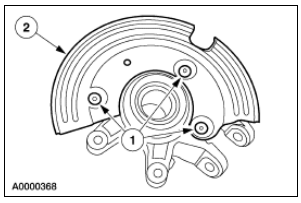
⚠ CAUTION: Suspension fasteners are critical parts because they affect the performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation is necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Remove the knuckle. For additional information, refer to Wheel Knuckle in this section.

2. **⚠ CAUTION: Use extreme care not to damage the knuckle when drilling out the dust shield rivets.**

   Remove the dust shield (2C028).

   1. Using a 5.5 mm (3/16 inch) drill bit, drill out the dust shield rivets. If a larger drill bit is needed, it must not be larger than 6 mm (1/4 inch).
   2. Remove the dust shield.

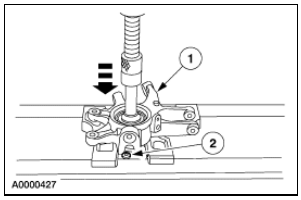


3. **⚠ CAUTION: When the wheel hub is pressed from the bearing, the bearing inner race will come out with the hub. Never try to install the race back into the bearing. Always install a new bearing.**

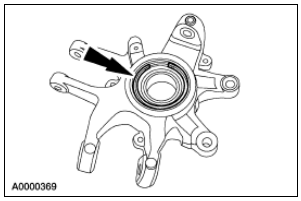
   ⚠ CAUTION: Make sure to keep the knuckle level and supported during pressing operations, or damage to the knuckle can occur. Support the knuckle as close to the bearing bore as possible. Do not use knuckle extremities as supports.

   Remove the hub (1109).

   1. Correctly support the knuckle in a press.
   2. Using the appropriate step plate adapter, press the hub from the bearing. The bearing inner race will come out with the hub.



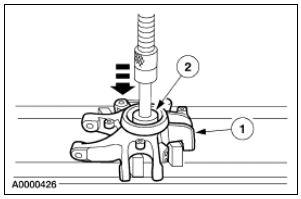
4. Remove the snap ring.



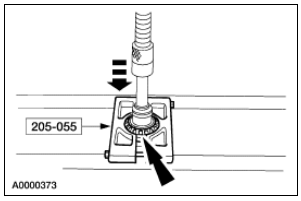
5. ⚠ **CAUTION: Make sure to keep the knuckle level and supported during pressing operations, or damage to the knuckle can occur. Support the knuckle as close to the bearing bore as possible. Do not use knuckle extremities as supports.**

   Remove the bearing (1244).

   1. Correctly support the knuckle in a press.
   2. Using the appropriate step plate adapter, press the bearing from the knuckle.



6. If the hub is to be reused, remove the bearing inner race from the hub using the special tool.



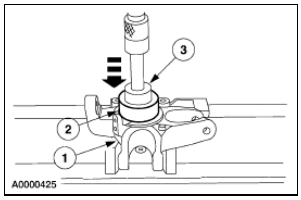
Installation

1. Thoroughly clean and inspect the wheel knuckle to bearing mating surface before installing the bearing.

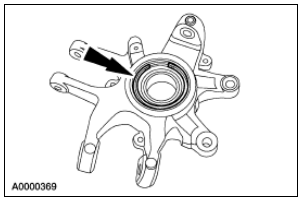
2. ⚠ **CAUTION: Make sure to keep the knuckle level and supported during pressing operations, or damage to the knuckle can occur. Support the knuckle as close to the bearing bore as possible. Do not use knuckle extremities as supports.**

   Install a new bearing.

   1. Correctly support the knuckle in a press.
   2. Position the new bearing in the knuckle.
   3. Using the appropriate step plate adapter, press the new bearing into the knuckle until the bearing clears the snap ring groove and bottoms out in the bore.



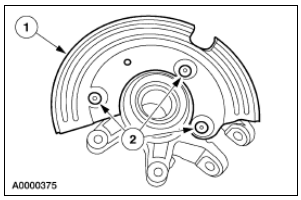
3. Install the snap ring.



4. ⚠ **CAUTION: Use only the appropriate size aluminum rivets on the rear brake disc dust shield. Galvanic corrosion will result if steel rivets are used.**

   Install the rear brake dust shield.

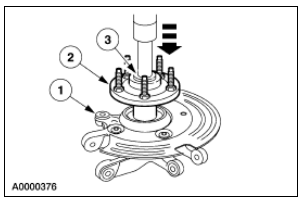
   1. Position the shield on the knuckle.
   2. Install the rivets.



5. ⚠ **CAUTION: The wheel bearing inner race must be supported during hub installation. Failure to do so will damage the bearing.**

   Install the hub.

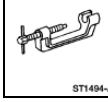
   1. Position the knuckle in a press, using the appropriate step plate adapter to support the wheel bearing inner race.
   2. Position the hub in the bearing.
   3. Using the appropriate step plate adapter, press the hub into the bearing.



6. Install the knuckle. For additional information, refer to Wheel Knuckle in this section.

Wheel Studs

Special Tool(s)

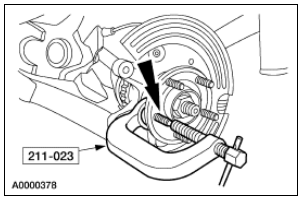
 ST1494-A	C-Frame and Screw 211-023 (T74P-3044-A1)

Removal

1. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
2. Remove the rear brake disc. For additional information, refer to Section 206-04 .
3. **NOTE:** Cut off 1 inch of the stud to ease removal if necessary.

   Using the special tool, press the wheel stud (1107) out of the rear hub (1109) between the caliper mounting pads.

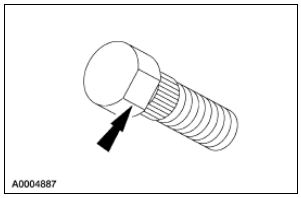
   - Discard the wheel stud. Do not reuse wheel studs.



Installation

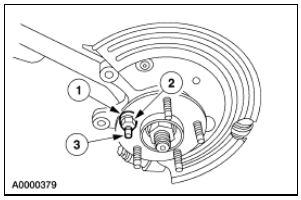
⚠ **CAUTION: Never use air tools to install wheel studs. The serrations can be stripped from the stud.**

1. If necessary, grind the head of a new wheel stud to a "D" shape to clear the wheel knuckle.



2. Position the new wheel stud into the hub flange, making sure the serrations on the stud are aligned with the serrations in the flange.
3. Install the wheel stud.
   1. Place four flat washers on the wheel stud.
   2. **NOTE:** Do not use the wheel nuts that came with the vehicle.

      Thread a standard wheel nut (1012) onto the wheel stud with the flat side against the washers.
   3. Tighten the wheel nut until the wheel stud head seats against the hub flange.



4. Remove the wheel nut and washers.

5. Install the rear brake disc. For additional information, refer to Section 206-04 .

6. Install the wheel and tire assembly. For additional information, refer to Section 204-04 .

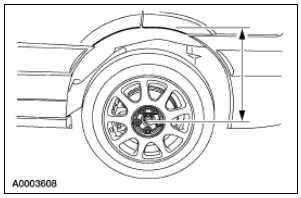
Upper Arm

Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect the performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation is necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

NOTE: The suspension upper arm bushings or ball joints are not serviced separately from the upper rear suspension arm. If the bushings or ball joints require service a new suspension upper arm (5500) must be installed.

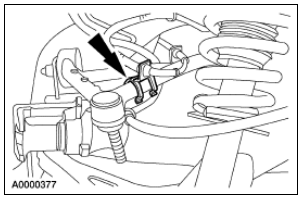
1. Remove the hub cap. Measure the distance from the center of the hub to the lip of the fender with the vehicle in a level, static ground position.



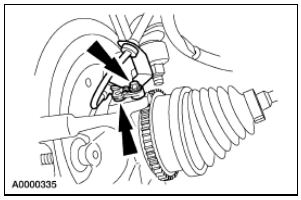
2. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .

3. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

4. Unclip the ABS sensor wire retainer from the suspension upper arm.



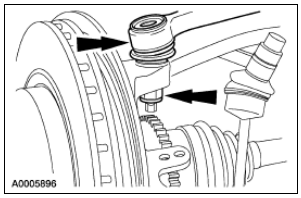
5. Remove the bolt and disconnect the ABS sensor. Position the sensor aside.



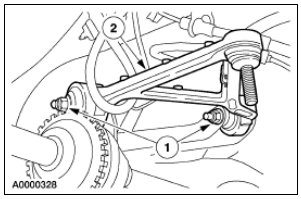
6. **⚠ CAUTION: Use care not to damage the anti-lock brake system (ABS) sensor ring. A damaged sensor ring will result in incorrect ABS operation.**

   NOTE: To remove the nut, first loosen the nut, then use the hex holding feature to prevent the ball joint from turning while removing the nut.

   Remove and discard the nut. Disconnect the ball joint from the knuckle.



7. Remove the suspension upper arm (5500).
    1. Remove the suspension upper arm-to-subframe nuts and bolts. Discard the nuts and bolts.
    2. Remove the suspension upper arm.



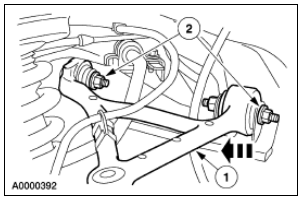
Installation

⚠ CAUTION: Do not tighten the suspension upper arm-to-subframe nuts until the suspension is at curb height. Failure to do so can cause severe damage to the bushings resulting in poor ride quality and handling.

1. **NOTE:** The bolts and nuts retaining the suspension upper arm are of a torque prevailing design. New bolts and nuts must be used.

   Install the suspension upper arm.

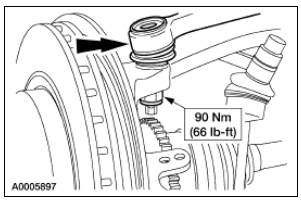
    1. Position the arm on the subframe.
    2. Install new nuts and bolts. Do not tighten at this time.



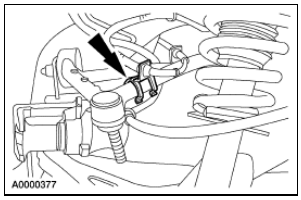
2. **⚠ CAUTION: Use care not to damage the anti-lock brake system (ABS) sensor ring. A damaged sensor ring will result in incorrect ABS operation.**

   NOTE: To install the nut, first install the nut using the hex holding feature until snug. Final tighten the nut using a line-type crow's foot and a torque wrench.

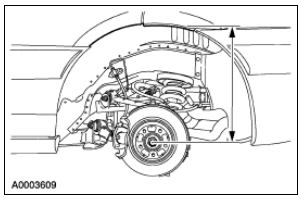
   Connect the ball joint to the knuckle and install a new nut.



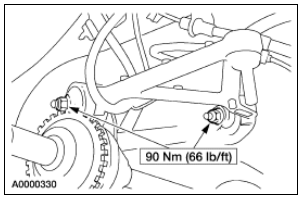
3. Clip the ABS sensor wire to the suspension upper arm.



4. Position a jack stand under the suspension lower arm and raise the suspension until the distance between the center of the hub and the lip of the fender is equal to the measurement taken in Removal, Step 1.



5. Tighten the nuts.



6. Lower the suspension and remove the jack stand.

7. Install the wheel and tire assembly. For additional information, refer to Section 204-04 .

8. Lower the vehicle.

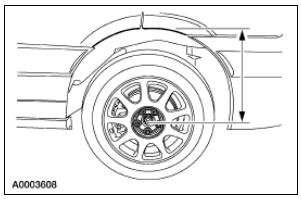
Lower Arm

Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect the performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation is necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

NOTE: The suspension lower arm bushings are not serviced separately from the lower suspension arm. If the bushings require service a new lower arm must be installed.

1. With the vehicle in a static, level ground position, remove the hub cap and measure the distance from the center of the hub (1109) to the lip of the fender (curb height).

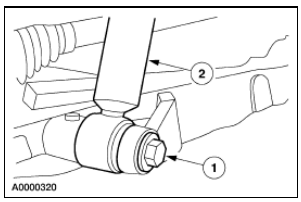


2. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .

3. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

4. Remove the rear brake disc. For additional information, refer to Section 206-04 .

5. Disconnect the shock absorber and spring assembly.
    1. Remove and discard the bolt.
    2. Disconnect the shock absorber and spring assembly from the lower arm and bushing.

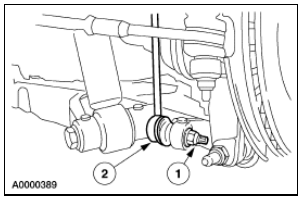


6. **⚠ CAUTION: Do not use air tools to remove the nut. Damage to the boot can result.**

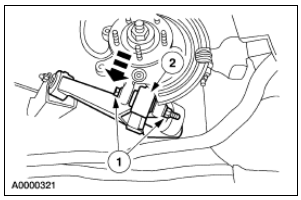
    NOTE: To remove the nut, first loosen the nut, then remove the nut using the hex holding feature to prevent the stabilizer bar link ball joint from turning.

    Disconnect the stabilizer bar link (5C488) from the suspension lower arm.

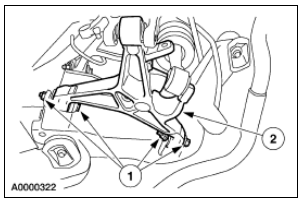
    1. Remove and discard the nut.
    2. Disconnect the stabilizer bar link.



7. Disconnect the suspension lower arm from the knuckle.
    1. Remove and discard the nut and bolt.
    2. Disconnect the suspension lower arm.



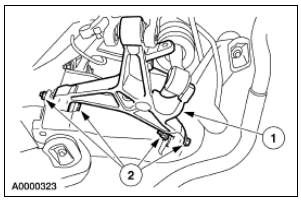
8. Remove the suspension lower arm and bushing.
    1. Remove and discard the nuts and bolts.
    2. Remove the suspension lower arm.



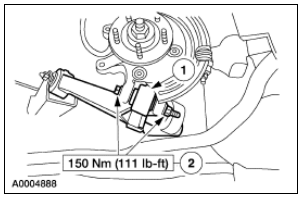
Installation

⚠ CAUTION: Do not tighten the suspension lower arm-to-subframe fasteners until the suspension is at curb height. Failure to do so can cause severe damage to the bushings resulting in poor ride quality and handling.

1. Install the suspension lower arm.
    1. Position the suspension lower arm onto the subframe (5R003).
    2. Install new bolts and nuts. Do not tighten at this time.



2. Connect the suspension lower arm to the knuckle.
    1. Position the suspension lower arm.
    2. Install a new bolt and nut. Tighten the nut.

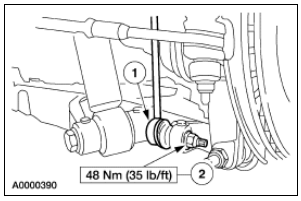


3. ⚠ **CAUTION: Do not use air tools to install the nut. Damage to the boot can result.**

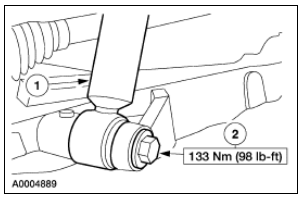
   NOTE: To install the nut, first install the nut until snug using the hex holding feature. Final tighten the nut using a socket and a torque wrench.

   Connect the stabilizer bar link to the suspension lower arm.

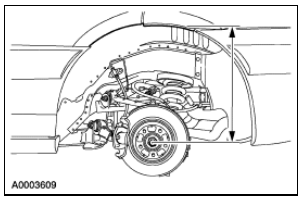
   1. Position the stabilizer bar link on the suspension lower arm.
   2. Install a new nut.



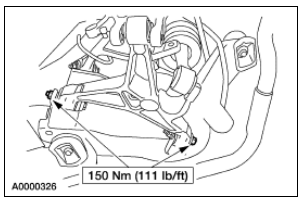
4. Install the rear shock absorber and spring assembly.
   1. Position the shock absorber and spring assembly onto the suspension lower arm.
   2. Install a new bolt.



5. Position a jack stand under the suspension lower arm and raise the suspension until the measurement between the center of the hub and the lip of the fender is equal to the measurement taken in Removal, Step 1 (curb height).



6. Tighten the lower suspension arm -to-subframe rear bolt. Tighten the suspension lower arm-to-subframe front nut.



7. Lower the suspension and remove the jack stand.

8. Install the rear brake disc. For additional information, refer to Section 206-04 .

9. Install the wheel and tire assembly. For additional information, refer to Section 204-04 .

10. Lower the vehicle.

Stabilizer Bar

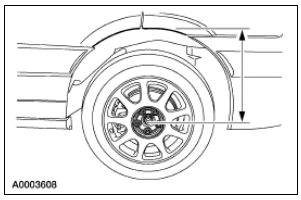
Special Tool(s)

 ST1293-A	Rotunda Powertrain Lift 014-00765 or Equivalent

Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect the performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation is necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Remove the hub cap and measure the distance from the center of the wheel hub to the lip of the fender with the vehicle in a static, level ground position (curb height).

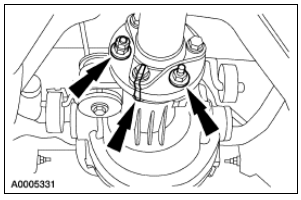

A0003608

2. Remove both wheel and tire assemblies. For additional information, refer to Section 204-04 .

3. Remove the muffler and heat shield. For additional information, refer to Section 309-00 .

4. **⚠ CAUTION: The driveshaft-to-pinion flange bolts, nuts and weighted nuts must be installed in the same locations from which they were removed.**

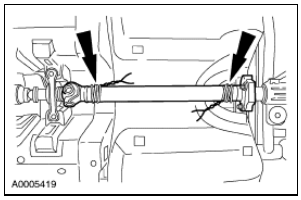
   Mark the pinion flange, the driveshaft flexible coupling and each of the three driveshaft-to-pinion flange bolts, nuts and weighted nuts with different color paint so that the driveshaft and differential may be realigned during installation.


A0005331

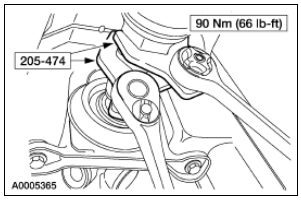
5. **⚠ CAUTION: Do not remove the flex coupling on the driveshaft flange. Make sure to remove only the driveshaft-to-pinion flange bolts and nuts.**

   Remove the three driveshaft-to-pinion flange bolts and nuts.

6. Support the driveshaft at the center and rear.



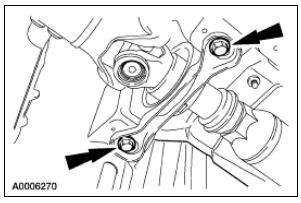
7. Loosen the driveshaft yoke adjuster nut.



8. **NOTE:** There are shims between the center bearing mounting bracket and the body.

   NOTE: The shims must be installed in their original locations.

   Remove the bolts and the shims.



9. Position special tool 014-00765, or equivalent, under the rear subframe (5R003).

10. ⚠ **WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are alway s present and may be ignited. Failure to follow these instructions can result in personal injury.**

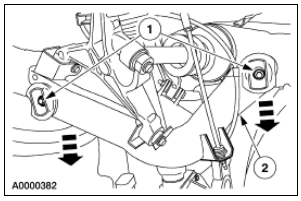
    ⚠ **CAUTION: Do not allow the subframe to hang from the shock absorbers. The shock absorbers can be damaged. Always keep the subframe supported on the special tool.**

    Lower the rear subframe.

    1. **NOTE:** Paint or otherwise mark the relative position of the subframe retaining bolts to the subframe bushings for assembly reference.

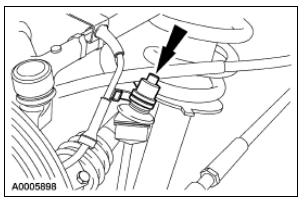
       Remove the four subframe bolts.
    2. ⚠ **CAUTION: To avoid damaging the fuel tank filler hose, do not lower the subframe more than specified.**

       Carefully lower the subframe approximately 56.25 mm (2.25 in) using the special tool.



NOTE: Components must be removed from both sides of the vehicle. Only the right side is shown.

11. Remove the cap from the stabilizer link.

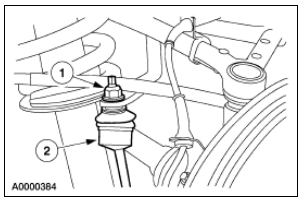


12. ⚠ **CAUTION: Do not use air tools to remove the nut. Damage to the boot can occur.**

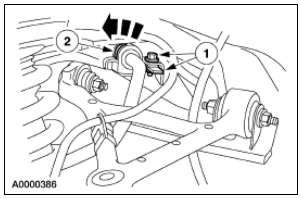
    NOTE: To remove the nut, first loosen the nut, then use the hex holding feature to prevent the stabilizer bar link ball joint from turning.

    Disconnect the rear stabilizer bar links (5C488) from the rear stabilizer bar (5A772).

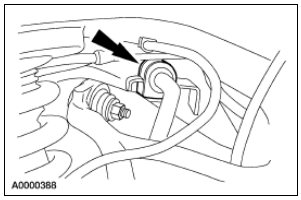
    1. Remove and discard the nuts.
    2. Disconnect the links from the bar.



13. Remove the stabilizer bar brackets.
    1. Remove the bolts and nuts.
    2. Remove the brackets.

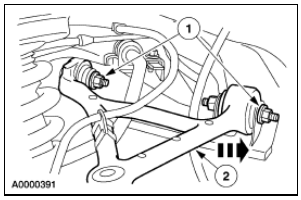


14. Remove the stabilizer bar bushings.



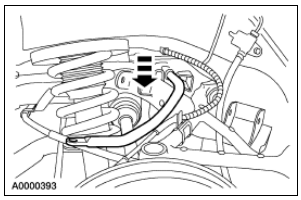
15. Secure the knuckles to the subframe with mechanic's wire.

16. Disconnect the suspension upper arms (5500) from the subframe.
    1. Remove and discard the nuts and bolts.
    2. Disconnect the arms and rotate them out of the way.



17. **NOTE:** The stabilizer bar can be removed from either side.

    Remove the stabilizer bar.

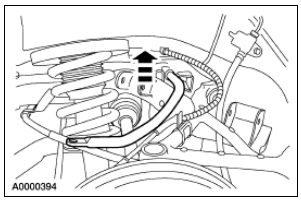


Installation

NOTE: Components on both sides of the vehicle must be installed or connected. Only the right side is shown.

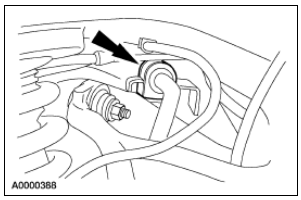
1. **NOTE:** The stabilizer bar can be installed from either side.

   Position the stabilizer bar in the vehicle.

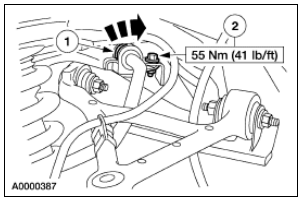


2. **NOTE:** If the stabilizer bar bushings are badly worn or have no grease, install new bushings. Do not grease the bushings.

   Install the stabilizer bar bushings.



3. Install the stabilizer bar brackets.
   1. Position the brackets on the bushings.
   2. Install the nuts and bolts.

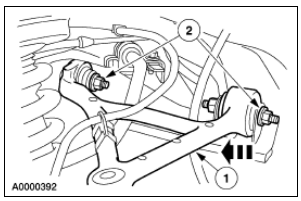


4. ⚠ **CAUTION: The suspension upper arm and bushing must be at curb height before the nuts**

can be tightened. Failure to do so will result in damage to the bushings resulting in poor ride quality and handling.

Connect the suspension upper arm and bushing to the subframe.

1. Position the arm on the subframe.
2. Install new bolts and nuts. Do not tighten the nuts at this time.



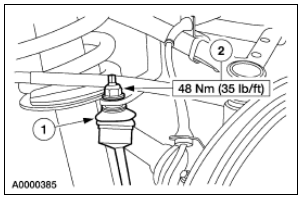
5. Remove the wires holding the knuckles to the subframe.

6. ⚠ **CAUTION: Do not use air tools to install the nut. Damage to the boot can occur.**

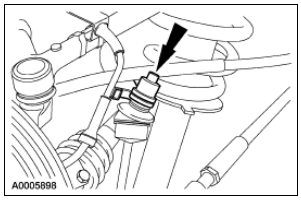
NOTE: To install the nut, first install the nut until snug using the hex holding feature. Final tighten the nut using a socket and a torque wrench.

Connect the stabilizer bar links to the stabilizer bar.

1. Connect the links to the bar.
2. Install new nuts.

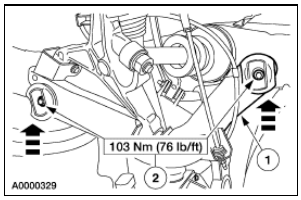


7. Install the protective cap on the stabilizer bar link.



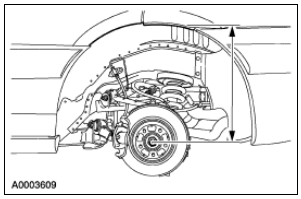
8. Secure the subframe to the body.
   1. Raise the subframe using the special tool.
   2. **NOTE:** Make sure the bolts are installed in the same position on the subframe bushings as they were before removal.

      Install the four bolts.

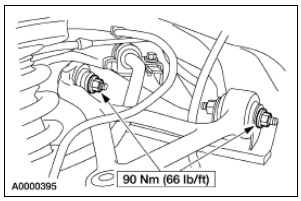


9. Remove the special tool.

10. Position jack stands under the suspension lower arm and bushings and raise the suspension until the distance between the center of the hub and the lip of the fender is equal to the measurement taken during Removal, Step 1 (curb height).



11. Tighten the suspension upper arm and bushing nuts.



12. Lower the suspension and remove the jack stands.

13. Connect the driveshaft to the rear axle housing. For additional information, refer to Section 205-01 .

14. Install both wheel and tire assemblies. For additional information, refer to Section 204-04 .

15. Lower the vehicle.

Stabilizer Bar Link

Removal

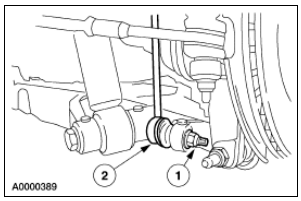
⚠ CAUTION: Suspension fasteners are critical parts because they affect the performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation is necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

1. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .
2. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .
3. **⚠ CAUTION: Do not use air tools to remove the nut. Damage to the boot can occur.**

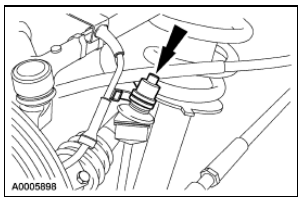
   NOTE: To remove the nut, first loosen the nut, then use the hex holding feature to prevent the stabilizer bar link ball joint from turning while removing the nut.

   Disconnect the stabilizer bar link (5C488) from the suspension lower arm.

   1. Remove and discard the nut.
   2. Remove the link from the arm.



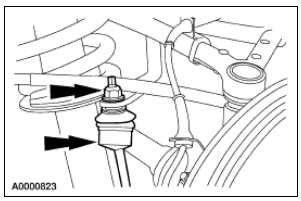
4. Remove the protective cap from the stabilizer bar link.



5. **⚠ CAUTION: Do not use air tools to remove the nut. Damage to the boot can occur.**

   NOTE: To remove the nut, first loosen the nut, then use the hex holding feature to prevent the stabilizer link ball joint from turning while removing the nut.

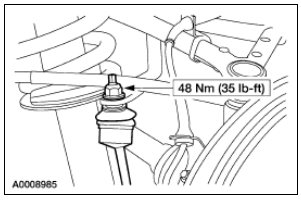
   Remove the nut and the stabilizer bar link. Discard the nut.

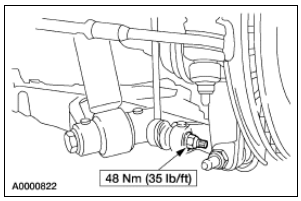


Installation

1. **NOTE:** The nuts retaining the stabilizer bar link are of a torque prevailing design and new nuts must be used during installation of the stabilizer bar link.

   To install, reverse the removal procedure.





Toe Link

Removal

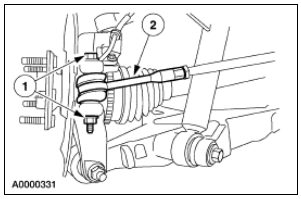
⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation is necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

NOTE: The toe links are not serviced separately. If a toe link requires service a new assembly must be installed.

1. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .

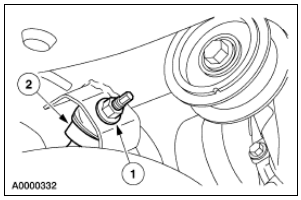
2. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

3. Disconnect the toe link from the knuckle.
    1. Remove and discard the nut and bolt.
    2. Disconnect the toe link.



4. Remove the toe link from the subframe.
    1. **NOTE:** To remove the nut, first loosen the nut, then use the hex holding feature to prevent the ball joint from turning while removing the nut.

       Remove and discard the nut.
    2. Remove the toe link.

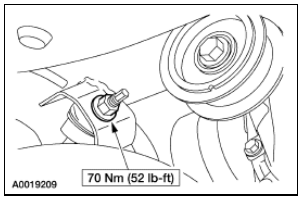


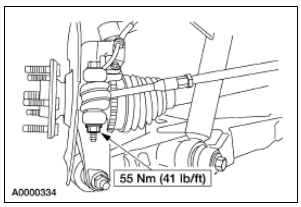
Installation

1. **NOTE:** The bolts and nuts retaining the toe link are of a torque prevailing design and new bolts and nuts must be used during installation of the toe link.

   NOTE: To install the toe link-to-subframe nut, first install the nut until snug while using the hex holding feature. Final tighten the nut using a socket and a torque wrench.

   To install, reverse the removal procedure.





2. Check wheel alignment. Adjust as necessary. For additional information, refer to Section 204-00 .

Stabilizer Bar Bushing

Special Tool(s)

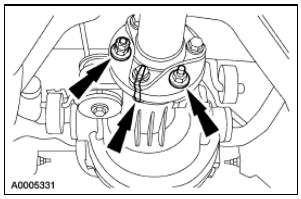
 ST1293-A	Rotunda Powertrain Lift 014-00765 or Equivalent

Removal

⚠ CAUTION: Suspension fasteners are critical parts because they affect the performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation is necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

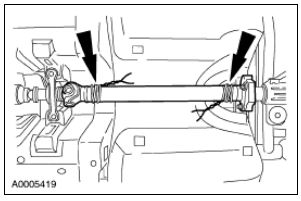
1. Remove both wheel and tire assemblies. For additional information, refer to Section 204-04 .
2. Remove the muffler and heat shield. For additional information, refer to Section 309-00 .
3. **⚠ CAUTION: The driveshaft-to-pinion flange bolts, nuts and weighted nuts must be installed in the same locations from which they were removed.**

   Mark the pinion flange, the driveshaft flexible coupling and each of the three driveshaft-to-pinion flange bolts, nuts and weighted nuts with different color paint so that the driveshaft and differential may be realigned during installation.

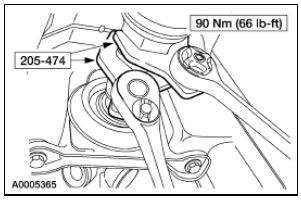

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4. **⚠ CAUTION: Do not remove the flex coupling on the driveshaft flange. Make sure to remove only the driveshaft-to-pinion flange bolts and nuts.**

   Remove the three driveshaft-to-pinion flange bolts and nuts.
5. Support the driveshaft at the center and rear.


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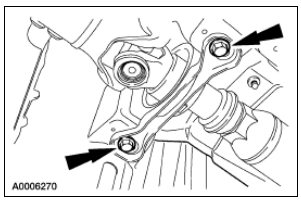
6. Loosen the driveshaft yoke adjuster nut.



7. **NOTE:** There are shims between the center bearing mounting bracket and the body.

   NOTE: The shims must be installed in their original locations.

   Remove the bolts and the shims.



8. Position the special tool 014-00765, or equivalent, under the rear subframe (5R003).

9. ⚠ **WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related components. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions can result in personal injury.**

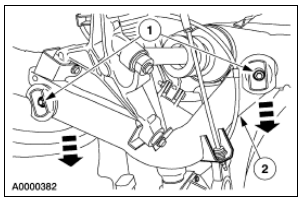
   ⚠ **CAUTION: Do not allow the subframe to hang from the shock absorbers. The shock absorbers can be damaged. Always keep the subframe supported on the special tool.**

   Lower the rear subframe.

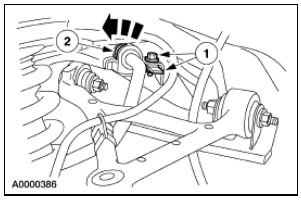
   1. **NOTE:** Paint or otherwise mark the relative position of the subframe retaining bolts to the subframe bushings for assembly reference.

      Remove the four subframe bolts.
   2. ⚠ **CAUTION: To avoid damaging the fuel tank filler hose, do not lower the subframe more than specified.**

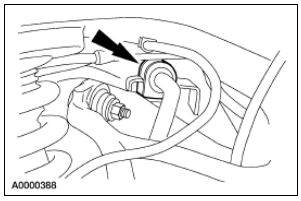
      Carefully lower the subframe approximately 56.25 mm (2.25 in) using the special tool 014-00765.



10. Remove the stabilizer bar bracket.
    1. Remove the bolt and nut.
    2. Remove the bracket.



11. Remove the stabilizer bar bushing.

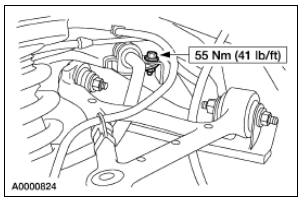


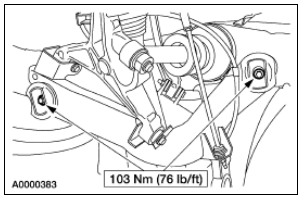
Installation

1. **NOTE:** If the stabilizer bar bushings are badly worn or have no grease, install new bushings. Do not grease the bushings.

   NOTE: Make sure the subframe-to-body bolts are installed in the same position on the subframe bushings as they were before removal.

   To install, reverse the removal procedure.





Wheel Knuckle

Special Tool(s)

 ST1516-A	Remover/Installer, Front Wheel Hub 204-069 (T81P-1104-C)
 ST1517-A	Adapter, Wheel Hub 205-237 (T86P-1104-A1)
 ST1518-A	Remover, Wheel Stud (Metric) 204-085 (T83P-1104-BH)

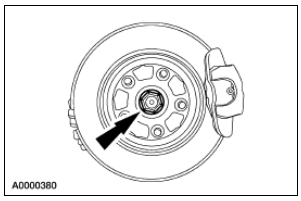
Removal

⚠ CAUTION: Suspension fasteners are important parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation is necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

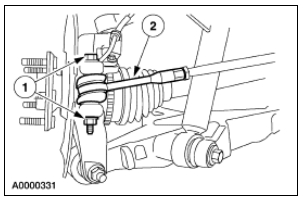
1. Remove the rear brake disc. For additional information, refer to Section 206-04 .

2. **⚠ CAUTION: The wheel hub retainer (4B477) is a one time use item and a new retainer must be installed when removed. Failure to do so can cause the retainer to come loose during vehicle operation resulting in loss of vehicle control.**

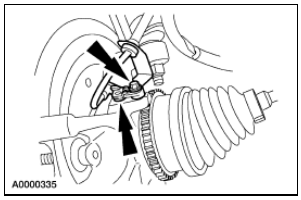
   Remove and discard the wheel hub retainer.



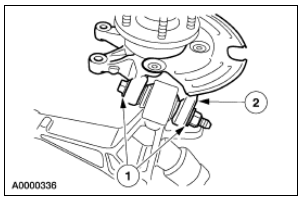
3. Disconnect the toe link from the knuckle.
   1. Remove and discard the nut and bolt.
   2. Disconnect the toe link.



4. Remove the bolt and disconnect the ABS sensor.

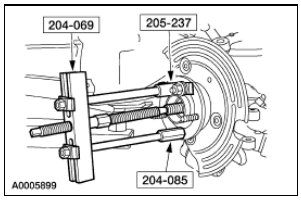


5. Disconnect the suspension lower arm from the knuckle.
    1. Remove the nut and bolt. Discard the nut.
    2. Disconnect the suspension lower arm and bushing.



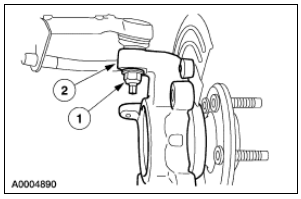
6. ⚠ **CAUTION: Support the axle shaft after removing it from the hub (1109). Failure to do so can damage the axle shaft.**

    Using the special tools, separate the axle shaft from the hub. Support the axle shaft.



7. Remove the knuckle.
    1. **NOTE:** To remove the nut, first loosen the nut, then use the hex holding feature to remove the nut while holding the ball joint.

        Remove and discard the suspension upper arm ball joint nut.
    2. Remove the knuckle.



8. Remove the hub. For additional information, refer to Wheel Hub in this section.

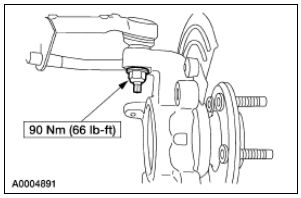
Installation

⚠ **CAUTION: Do not tighten the suspension lower arm fasteners until the suspension is at curb height. Failure to do so can cause severe damage to the bushings resulting in poor ride quality and handling.**

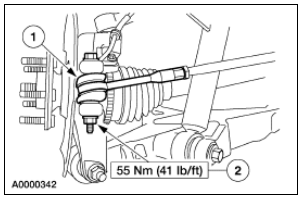
1. Install the hub. For additional information, refer to Wheel Hub in this section.

2. **NOTE:** The hex holding feature can be used to prevent turning of the stud while tightening the nut.

    Position the knuckle on the suspension upper arm ball joint stud and install a new nut.

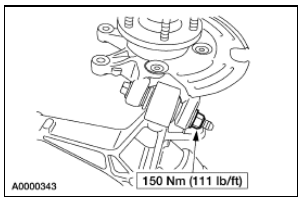


3. Install the toe link.
    1. Position the toe link onto the knuckle.
    2. Install a new bolt and nut.

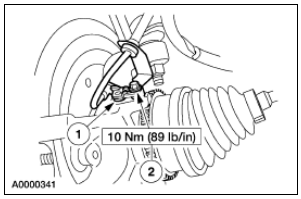


4. Install the axle shaft into the hub. Make sure the splines on the shaft line up with the splines in the hub.

5. Position the knuckle onto the suspension lower arm and install a new bolt and nut. Tighten the nut.



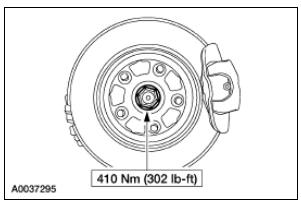
6. Install the ABS sensor.
    1. Install the sensor.
    2. Install the bolt.



7. Install the rear brake disc. For additional information, refer to Section 206-04 .

8. **NOTE:** Lower the vehicle and apply the parking or service brakes before tightening the wheel hub retainer.

    Install a new wheel hub retainer.



9. Install the wheel and tire. For additional information, refer to Section 204-04 .

Shock Absorber and Spring Assembly

Removal and Installation

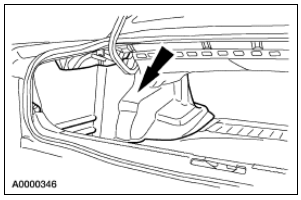
⚠ WARNING: All vehicles are equipped with gas-pressurized rear shock absorbers which will extend unassisted. Do not apply heat or flame to the shock absorbers during removal or component service. Failure to do so may cause personal injury.

⚠ CAUTION: Suspension fasteners are critical parts because they affect performance of vital components and systems and their failure can result in major service expense. A new part with the same part number must be installed if installation is necessary. Do not use a new part of lesser quality or substitute design. Torque values must be used as specified during reassembly to make sure of correct retention of these parts.

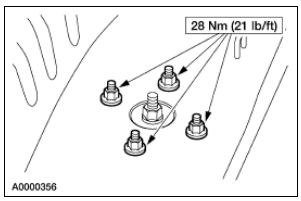
NOTE: Shock absorber and spring removal is the same for both sides. The left side is shown.

1. Open the luggage compartment lid.

2. Position the trim cover aside.

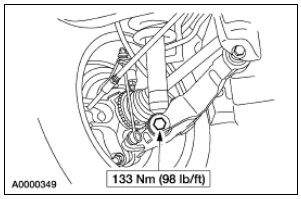


3. Remove and discard the nuts.



4. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .

5. Remove the bolt and the shock absorber and spring assembly.
   - Discard the bolt.



6. To install, reverse the removal procedure.

Shock Absorber and Spring Assembly

For additional information, refer to Section 204-01 .

General Specifications

Item	Specification
Wheel stud and wheel nuts (metric)	M12x1.5-19 mm hex
Maximum tire balance weight	140 g (5.0 oz) per wheel 70 g (2.5 oz) per flange
Wheel bolt circle runout	0.65 mm (0.02 in)
Tire Inflation	
Tires	See safety certification sticker located on driver door jamb or tire inflation placard on the passenger door jamb.
Tire Tread Depth	
P215/60R16 94H	8.6 mm (0.34 in)
P215/60R16 94V	8.4 mm (0.33 in)
215/60R16 95W	8.1 mm (0.32 in)
235/50R17 95V	8.4 mm (0.33 in)
245/45R17 95W	7.6 mm (0.30 in)
Wheels	
Painted aluminum	16x7J
Bright machined aluminum	16x7J
Bright polished aluminum	16x7J
Painted aluminum	17x7.5J
Wheel offset	60 mm (2.4 in)
Wheel bolt circle runout	0.65 mm (0.02 in)
Cleaners Wheel	
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A
Custom Bright Metal Cleaner 8A-19522-A	ESR-M5B194-B
Repair Compound	
Aluminum Wheel Repair Compound	ESA-M4G280-A

Wheel Rim Runout

Max. radial runout	Max. lateral runout
0.64 mm (0.02 in)	0.89 mm (0.03 in)

Tire Runout Specifications

Max. radial runout	Max. lateral runout
1 mm (0.04 in)	2 mm (0.08 in)

Torque Specifications

Description	Nm	lb-ft
Wheel nuts	135	100

Wheels and Tires

Part # -1007-	Color/Style	Wheel Size	No. of Bolts	Bolt Circle Diameter	Offset	Tire Usage
-	Steel or aluminum mini-spare	16 X 4	5	107.95 mm (4.31 in)	40	T145/80R16 105
-	Silver sparkle, forged aluminum/9 spoke	16 X 7	5	107.95 mm (4.31 in)	60	P215/60R16 94H or 215/60R16 95W
-	Bright machined, forged aluminum/5 spoke	16 X 7	5	107.95 mm (4.31 in)	60	P215/60R16 V rated or 215/60R16 95W
-	Bright polished forged aluminum/5 spoke	16 X 7	5	107.95 mm (4.31 in)	60	P215/60R16 94H or P215/60R16 94V or 215/60R16 95W
-	Silver gray cast aluminum/5 spoke	17 X 7.5	5	107.95 mm (4.31 in)	60	P235/50R17 95V or 245/45R17 95W

Safety Precautions

⚠ WARNING: Never run the engine with one wheel off the ground, for example, when changing a tire. The wheel(s) resting on the ground can cause the vehicle to move.

⚠ WARNING: The tire and wheel must always be correctly matched. It is very important to determine the size of each component before any assembly operations commence. Failure to adhere to these instructions can result in an explosive separation and cause serious bodily injury or death.

⚠ WARNING: Aftermarket aerosol tire sealants are extremely flammable. Always question the customer to make sure these products have not been used.

⚠ WARNING: Aftermarket wheel assemblies may not be compatible with the vehicle. Use of incompatible wheel assemblies can result in equipment failure and possible injury. Use only approved wheel assemblies.

⚠ WARNING: Use only wheels and wheel nuts that have been designed for current model year Ford vehicles. Aftermarket wheels or wheel nuts may not fit or function correctly, and can cause personal injury or damage the vehicle.

⚠ WARNING: Always wear safety goggles or a face shield when performing any work with tire and wheel assemblies.

⚠ CAUTION: Do not clean aluminum wheels with steel wool, abrasive-type cleaners or strong detergents. Use Custom Bright Metal Cleaner 8A-19522-A or equivalent meeting Ford specification ESR-M5B194-B.

⚠ CAUTION: Reduce the air pressure as much as possible by pushing the valve core plunger in prior to removing the valve core. Avoid working in a position in which the face or body is directly over a tire in which there is pressure.

When carrying out any inspection or repair procedures on wheels (1007) and tires, follow the preceding safety precautions.

Wheels And Tires

⚠ WARNING: Do not mix different types of tires, such as radial, bias, or bias-belted, on the same vehicle except in emergencies (temporary spare usage). Vehicle handling can be seriously affected and can result in loss of control.

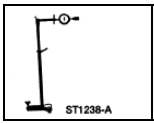
If the vehicle is equipped with uni-directional tires, mount the tires on the vehicle only in accordance with the manufacturer's instructions for direction of rotation printed on the side wall.

Original equipment uni-directional full-size spare tires can be operated with rotation counter to the directional arrow on the tire sidewall, but will perform best when rotating with the directional arrow on the sidewall.

Factory-installed tires and wheels are designed to operate satisfactorily with loads up to and including full-rated load capacity when inflated to recommended inflation pressures.

Wheels And Tires

Special Tool(s)

 ST1238-A	Radial Runout Gauge 418-F123 (007-0056A) or Equivalent

Inspection and Verification

⚠ WARNING: Never run the engine with one wheel off the ground, for example, when changing a tire. The wheel(s) resting on the ground can cause the vehicle to move.

⚠ WARNING: Do not balance the wheels and tires while they are mounted on the vehicle. Possible tire disintegration or differential failure can result, causing personal injury and extensive component damage. Use off-vehicle wheel and tire balancer only.

Be sure to follow the warnings when performing inspection and verification.

Road Test

Verify the customer concern by performing a road test on a smooth road. If any vibrations are apparent, go to Section 100-04 .

To maximize tire performance, inspect for signs of incorrect inflation and uneven wear, which can indicate a need for balancing, rotation, or front suspension alignment.

Correct tire pressure and driving techniques have an important influence on tire life. Heavy cornering, excessively rapid acceleration and unnecessary sharp braking increases tire wear.

New tires must follow the recommended:

- tire sizes.
- speed rating.
- load range.
- tire construction type.

Use of any other tire size or type can seriously affect:

- ride.
- handling.
- speedometer/odometer calibration.
- vehicle ground clearance.
- tire clearance between the body and chassis.
- wheel bearing life.
- brake cooling.

New wheels need to be installed when:

- bent.
- cracked.
- dented.
- heavily corroded.
- leaking.
- they have elongated wheel hub bolt holes.
- they have excessive lateral or radial runout.

Wheel and tire assemblies are attached by five wheel nuts.

It is mandatory to use only the tire sizes recommended on the tire chart attached to the vehicle. Larger or smaller tires can damage the vehicle, affect durability, and require changing the speedometer calibration. Make sure wheel size and offsets match those recommended for the tire in use.

1. Inspect for signs of uneven wear that can indicate a need for balancing, rotation, front suspension alignment, damaged tie-rod, or steering components.

2. Check tires for:
   - cuts.
   - stone bruises.
   - abrasions
   - blisters.
   - embedded objects.

3. Tread wear indicators are molded into the bottom of the tread grooves. Install a new tire when the indicator bands become visible.

Symptom Chart

Symptom Chart

Component Tests

Tire and Wheel Runout

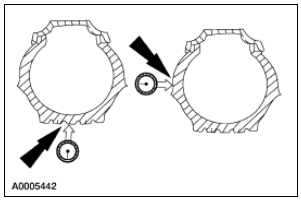
Excessive radial and lateral runout of a wheel and tire assembly can cause roughness, vibration, wheel tramp, tire wear, and steering wheel tremor.

Before checking runout, and to avoid false readings caused by temporary flat spots in the tires, check runout only after the vehicle has been driven far enough to warm the tires.

The extent of the runout is measured with the radial runout gauge. All measurements are made on the vehicle with the tires inflated to recommended inflation pressures and with the front wheel bearings adjusted to specifications.

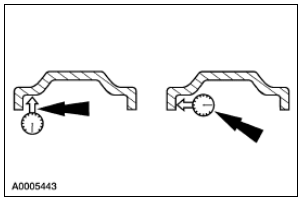
Tire Runout

Measure radial and lateral tire runout at the positions shown in the illustration. Runout should not exceed specifications.



Wheel Runout

Measure radial and lateral wheel runout at the positions shown in the illustration. Runout should not exceed specifications. Note that the tire has been removed.



Wheel Leaks

⚠ WARNING: Wheel repairs that use welding or peening are not approved. An inner tube is not an acceptable repair for leaking wheels (1007) or tires.

If the air pressure in a tire mounted on an aluminum wheel is found to be low, carry out the following procedure before considering installation of a new wheel.

1. Remove the wheel and tire assembly and inspect the wheel for structural damage. If none exists, go to Step 2. If the wheel is damaged, install a new wheel.

2. With the tire mounted on the wheel, locate the air leak using a water bath or equivalent method, and mark the location. Check the complete wheel for possible additional leaks. When the leaks are marked, dismount the tire, marking valve location on the tire for correct indexing.

3. On the tire side of the wheel, thoroughly clean the leaking area with an appropriate cleaner (Metal Surface Cleaner F4AZ-19A536-RA or equivalent meeting Ford specification WSE-M5B392-A) or use sandpaper of approximately 80-grit to remove all contamination. Using the sandpaper, score the surface of the leaking area to improve adhesion of the sealer. If the valve stem is close to the area, remove it.

4. Use a clean cloth to remove all cleaner and sanding dust.

5. **NOTE:** Do not use a torch containing oxyacetylene.

   Heat the prepared area with a Heat Gun or a propane torch. Apply Aluminum Wheel Repair Compound meeting Ford specification ESA-M4G280-A or equivalent over the prepared area using a liberal flow and wiping action. Repair is most effective when heat is applied to the brake side of the rim, and the sealer is melted by heat in the metal.

6. Apply only enough heat to melt the sealer, then remove the heat source. After repairing the leak, allow the wheel to cool until it can be handled safely.

7. **⚠ CAUTION: Use caution when mounting the tire so as not to damage the sealer.**

   Index and assemble the wheel and tire. Inflate the tire to the recommended pressure as indicated on the tire pressure decal.

8. Repeat Step 2 to verify repair.

9. When the repair is completed, balance the assembly and install it on the vehicle.

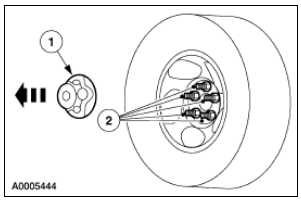
Wheel And Tire

Removal

1. ⚠ **CAUTION: Do not use heat to loosen a seized wheel nut (1012). Heat can damage the wheel and wheel bearings.**

   Loosen the wheel nuts.

   1. Remove the hub cap.
   2. With the weight of the vehicle on the tires, loosen the wheel nuts.



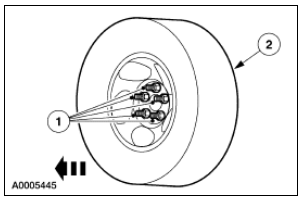
2. ⚠ **CAUTION: Never use the differential housing as a lifting point.**

   Raise and support the vehicle. For additional information, refer to Section 100-02 .

3. ⚠ **CAUTION: Do not use heat to loosen a seized wheel because heat can damage the wheel and the wheel bearings. If the wheel cannot be removed by hand, use a wheel puller to remove the seized wheel.**

   Remove the wheel and tire assembly.

   1. Remove the wheel nuts.
   2. Remove the wheel and tire assembly, using a side-to-side rocking motion.



Installation

1. ⚠ **WARNING: When a wheel is installed, always remove any corrosion, dirt or foreign material present on the mounting surfaces of the wheel and the surface of the wheel hub, brake drum or brake disc that contacts the wheel. Installing wheels without correct metal-to-metal contact at the wheel mounting surfaces can cause the wheel nuts to loosen and the wheel to come off while the vehicle is in motion, causing loss of control.**

   NOTE: If there is significant corrosion of the nut or stud threads, lubricate the threads with a drop of oil prior to installation.

   NOTE: When the wheel nuts are used to attach the mini-spare, and are correctly installed, the cone seat of the nut body will be in contact with the cone seat of the wheel. The washer on the nut will not

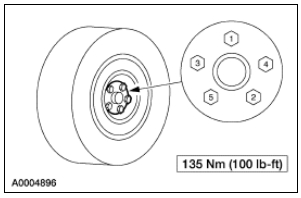
be in contact with the wheel and will spin freely.

Clean the wheel and the wheel hub mounting surface.

2. Install the wheel and tire assembly.
    1. Position the wheel and tire assembly.
    2. Install the wheel nuts hand-tight, then lower the vehicle.

3. ⚠ **CAUTION: Failure to tighten the wheel nuts in a star pattern can result in high brake disc runout, which will speed up the development of brake roughness, shudder and vibration.**

    Tighten the wheel nuts to specification in a star-pattern sequence.



General Specifications

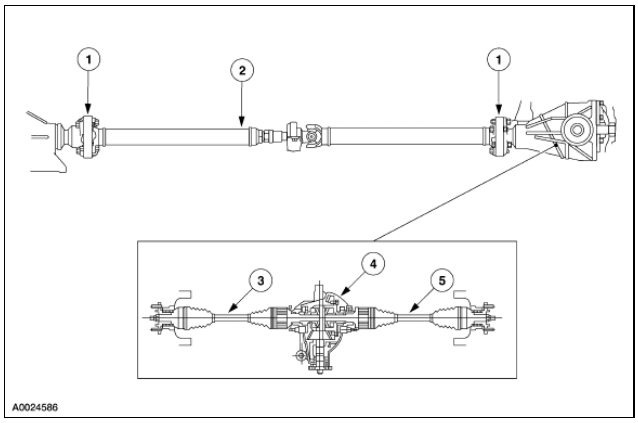
Item	Specification
SAE 75W-140 Synthetic Rear Axle Lubricant F1TZ-19580-B (in Canada CXY-75W140-16)	WSL-M2C192-A
Driveshaft Slip-Yoke	
Premium Long-Life Grease XG-1-C	ESA-M1C75-B
Capacities	
Rear axle	1.4L (3.0 pts)
Sealant	
Threadlock and Sealer E0AZ-19554-AA (in Canada CXC-76)	WSK-M2G351-A5
Stud and Bearing Mount E0AZ-19554-BA (in Canada CXC-70)	WSK-M2G349-A1

Driveshaft Angle Specifications

Transmission to Front Driveshaft	Front Driveshaft to Rear Driveshaft	Rear Driveshaft to Rear Axle Drive Pinion
(+1.0 degree) to (-0.0 degree)	(-0.4 degree) to (-1.4 degree)	(+1.0 degree) to (-0.0 degree)

Driveline System

Driveline Component Locations



Item	Part Number	Description
1	4684	Flex coupling
2	4602	Driveshaft assembly
3	3B436	Halfshaft (RH)
4	4010	Rear axle housing
5	3B437	Halfshaft (LH)

The driveline transfers engine torque to the drive wheels. Power is transmitted through the transmission to the driveshaft (4602) and then to the axle which is connected to the halfshafts.

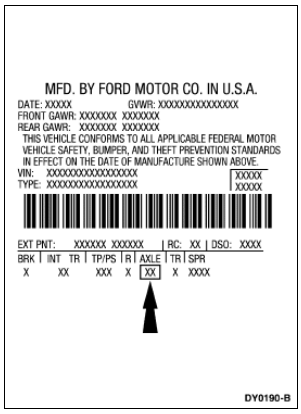
For additional information on the halfshaft, refer to Section 205-05 .

For additional information on the driveshaft, refer to Section 205-01 .

For additional information on the rear axle, refer to Section 205-02 .

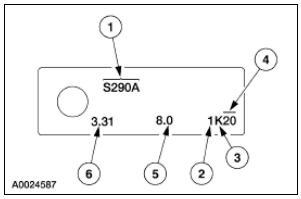
The engine angle is built into the engine mounts. If the engine angle is out of specification, the engine mounts must be inspected for damage. For additional information, refer to Section 303-00 .

Vehicle Certification (VC) Label Example



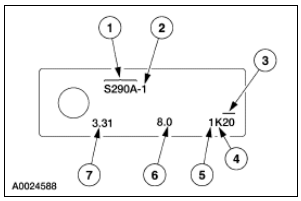
The vehicle certification (VC) label is located in the driver door jamb. The axle code is on the VC label. For additional information on the VC label, refer to Section 100-01 .

Axle Identification Tag



Item	Description
1	Plant code
2	Build year
3	Build month
4	Build day
5	Ring gear diameter (inch)
6	Axle ratio

Axle Identification Tag Denoting Interchangeability Affected Internally



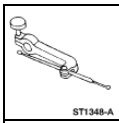
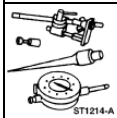
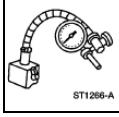
Item	Description
1	Plant code
2	Denotes interchangeability affected internally
3	Build day
4	Build month
5	Build year
6	Ring gear diameter (inch)
7	Axle ratio

⚠ CAUTION: The axle identification tag is the official identifier. Do not damage the tag. Always reinstall the tag after removing it for axle inspection/repair.

The plant code denotes a particular axle design and specific ratio. In addition, the plant code will not change as long as that particular axle assembly never undergoes an external design modification. If, however, an internal design modification takes place during the production life of the axle and that internal modification affects parts interchangeability, a dash and numerical suffix is added to the plant code. This means that, as an assembly, both axles are interchangeable; however, internally they are different. Therefore, each requires different internal parts at the time of repair.

Driveline System

Special Tool(s)

 ST1348-A	Gauge, Clutch Housing 308-021 (T75L-4201-A)
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST1266-A	Dial Indicator Gauge with Holding Fixture 100-D002 (D78P-4201-B) or equivalent

Inspection and Verification

Certain axle and driveline trouble symptoms are also common to the engine, transmission, wheel bearings, tires, and other parts of the vehicle. For this reason, be sure that the cause of the concern is in the axle before disassembling, adjusting or repairing the axle. For additional information, refer to Section 100-04 .

Certain driveshaft vibration symptoms are common to the accessory drive components, the engine, transmission or tires. Be sure the cause of the concern is the driveshaft before repairing or installing a new driveshaft. For additional information, refer to Section 100-04 .

Noise Acceptability

A gear-driven unit will produce a certain amount of noise. Some noise is acceptable and audible at certain speeds or under various driving conditions such as a newly paved blacktop road. Slight noise is not detrimental to the operation of the axle and is considered normal.

Flex Coupling Inspection

Check for visible reinforcing cords and signs of tearing, cracking or wear. If the flex couplings show signs of damage, inspect the rear axle mounts for cracking and tearing.

Driveshaft Center Universal Joint (U-Joint) Inspection

Place the vehicle on a frame hoist and rotate the driveshaft (4602) by hand. Check for rough operation or seized U-joint. The U-joint is not serviceable. If required, install a new complete driveshaft assembly. For additional information, refer to Section 205-01 .

Driveshaft Center Bearing

Rotate the driveshaft by hand. If the bearing shows signs of roughness or is noisy, install a new bearing assembly.

Analysis of Leakage

Clean up the leaking area enough to identify the exact source. An axle leak can be caused by the following:

- Axle lubricant level is too high.
- Worn or damaged axle shaft seals.
- Differential housing is cracked.
- Flange yoke seal is worn or damaged.
- Pinion flange is scored or damaged.
- Axle cover is not sealed.
- Vent is plugged.

Make sure the axle lubricant level for both nodular iron and aluminum housings is 3-5 mm (1/8-3/16 inch) below the bottom of the fill hole.

Axle Vent

NOTE: If a plugged vent cannot be cleared, install a new vent.

A plugged vent will cause excessive seal lip wear due to internal pressure buildup. If a leak occurs, check the vent. Make sure the vent hose is not kinked. Remove the hose from the vent nipple and clear the hose of any foreign material. While the hose is removed, pass a length of mechanics wire or a small diameter Allen wrench in and out of the vent to clean it. Connect the hose when done.

Flange Yoke Seal

Leaks at the axle drive pinion seal originate for the following reasons:

- Damaged seal.
- Worn seal journal surface.

Any damage to the seal bore (dings, dents, gouges, or other imperfections) will distort the seal casing and allow leakage past the outer edge of the axle drive pinion seal.

The axle drive pinion seal can be torn, cut, or gouged if it is not installed carefully. The spring that holds the axle drive pinion seal against the pinion flange may be knocked out and allow leakage past the lip.

Metal chips trapped at the sealing lip can cause oil leaks. These can cause a wear groove on the pinion flange and pinion seal wear.

A new pinion flange must be installed if any of these conditions exist.

If a seal leak occurs, install a new seal and check the vent and the vent hose to make sure they are clean and free of foreign material.

Differential Seals

Stub shaft pilot bearing housing seals are susceptible to the same kinds of damage as axle drive pinion seals if incorrectly installed. The seal bore must be clean and the lip handled carefully to avoid cutting or tearing it. The seal journal surface must be free of nicks, gouges and rough surface texture.

For additional information on differential seals, refer to Section 205-02 .

Analysis of Vibration

Few vibration conditions are caused by the rear axle. On a vibration concern, follow the diagnosis procedure in Section 100-04 unless there is a good reason to suspect the axle.

Tires

⚠ WARNING: Do not balance the wheels and tires while they are mounted on the vehicle. Possible tire disintegration/differential/halfshaft failure can result, causing personal injury/extensive component damage. Use an off-vehicle wheel and tire balancer only.

Most vibration in the rear end is caused by tires or driveline angle.

Vibration is a concern with modern, high-mileage tires if they are not "true" both radially and laterally. They are more susceptible to vibration around the limits of radial and lateral runout of the tire and wheel assembly. They also require more accurate balancing. Wheel and tire runout checks, truing and balancing are normally done before axle inspection. For additional information, refer to Section 204-04 .

Driveline Angle

Driveline angularity is the angular relationship between the engine crankshaft (6303), the driveshaft and the rear axle pinion. Factors determining driveshaft center bearing height, rear axle and engine/transmission mounts.

An incorrect driveline (pinion) angle can often be detected by the driving condition in which the vibration occurs.

- A vibration during coasting from 72 to 56 km/h (45 to 35 mph) is often caused by a high axle pinion angle.
- A vibration during acceleration from 56 to 72 km/h (35 to 45 mph) may indicate a low pinion angle.

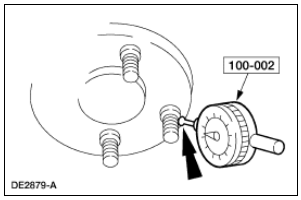
When these conditions exist, check the driveline angles.

If the tires and driveline angle are not the cause, carry out the NVH tests to determine if the concern is caused by a condition in the axle. For additional information, refer to Section 100-04 .

Wheel Hub Flange Bolt Circle Runout

NOTE: The brake discs must be removed to carry out all runout measurements.

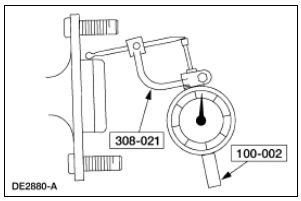
1. Position the special tool perpendicular to the wheel hub bolt, as close to the hub face as possible. Zero the indicator to allow the pointer to deflect either way.



2. Rotate the hub until the next bolt is contacted. Record the measurement and continue until each bolt is checked. The difference between the maximum and minimum contact readings will be the total wheel hub bolt pattern runout. The runout must not exceed 0.38 mm (0.015 inch).

Pilot Runout

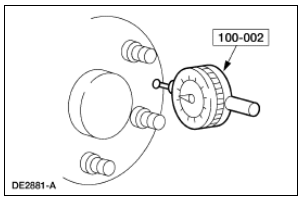
1. Position the special tools as close to the hub face as possible. Zero the indicator to allow the pointer to deflect either way.



2. Rotate the hub one full turn and note the maximum and minimum readings. The difference between the maximum and minimum readings will be the total pilot runout. Pilot runout must not exceed 0.15 mm (0.006 inch).

Wheel Hub Face Runout

1. Position the special tool on the wheel hub face, as close to the outer edge as possible. Zero the indicator to allow the pointer to deflect either way.



2. Rotate the hub one full turn and note the maximum and minimum readings. The difference between the maximum and minimum readings will be the total face runout. The runout must not exceed 0.254 mm (0.010 inch).

Drive Pinion Stem and Pinion Flange

Check the pinion flange runout when all other checks have failed to show the cause of vibration.

One cause of excessive pinion flange runout is incorrect installation of the axle drive pinion seal. Check to see if the spring on the seal lip has been dislodged before installing a new ring gear and pinion.

Halfshafts, Rear Wheel

NOTE: Install new constant velocity (CV) joints only if disassembly and inspection reveals unusual wear. For additional information, refer to Section 205-05 .

NOTE: While inspecting the boots, watch for indentations ("dimples") in the boot convolutions. Indentations must be removed.

- Inspect the boots for evidence of cracks, tears or splits.
- Inspect the underbody for any indication of grease splatter near the boots outboard and inboard locations. This is an indication of boot/clamp damage.

Component Tests

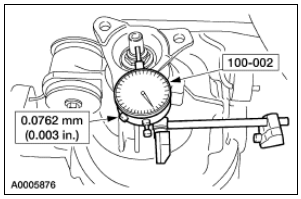
Driveline Vibration

Driveline vibration exhibits a higher frequency and lower amplitude than does high-speed shake. Driveline vibration is directly related to the speed of the vehicle and is usually noticed at various speed ranges. Driveline vibration can be perceived as a tremor in the floorpan or is heard as a rumble, hum or boom. Driveline vibration can exist in all drive modes, but may exhibit different symptoms depending upon whether the vehicle is accelerating, decelerating, floating or coasting. Check the driveline angles if the vibration is particularly noticeable during acceleration or deceleration, especially at lower speeds. Driveline vibration can be duplicated on a hoist. When carrying out an on-hoist test, the suspension lower arms must be supported with jack stands to make sure the halfshafts maintain the correct ride height. The brakes may need to be applied lightly in order to simulate road resistance.

Pinion Flange Runout Check

⚠ CAUTION: Pinion bearing preload must be reset if the pinion nut has been loosened or removed for pinion flange reindexing or new component installation.

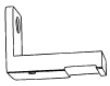
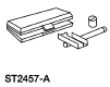
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the driveshaft. For additional information, refer to Section 205-01 .
3. Check the pinion flange for damage.



4. Check the runout using the special tool. Rotate the pinion until the runout is obtained. If the runout is still more than 0.0762 mm (0.003 inch), install a new gearset.
5. If excessive runout is still evident after installation of a new pinion flange, install a new ring and pinion. Repeat the above checks until the runout is within specifications.
6. Install the driveshaft. For additional information, refer to Section 205-01 .

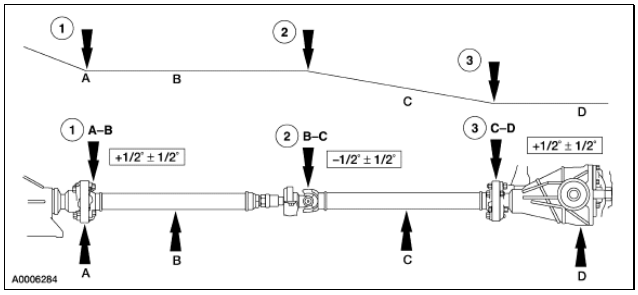
Driveline Angle Inspection

Special Tool(s)

 ST2456-A	Adapter, Driveline Angle 205-449
 ST2457-A	Gauge, Drive Pinion Angle 205-025 (T68P-4602-A)

⚠ CAUTION: When carrying out operations which involve the removal and installation of the driveshaft, always check the joint angles and make the necessary adjustments.

NOTE: The following illustration will be referred to throughout the Driveline Angle Inspection procedure.

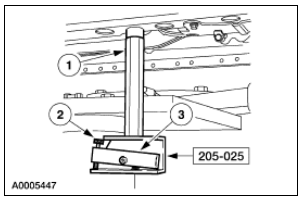


1. Park the vehicle on a level surface such as an alignment rack or a drive-on hoist.

2. Remove the exhaust heat shield fasteners and slide the exhaust heat shield as far forward as possible to expose the driveshaft-to-axle coupling. For additional information, refer to Section 309-00 .

3. Rotate the driveshaft several times by hand to neutralize the center support bearing and flex couplings.

4. Zero the special tool.
    1. Place the special tool on the left frame rail with the special tool facing the passenger side.
    2. Zero the special tool using the thumbscrew.
    3. Mark the location where the special tool was zeroed with a paint pen.

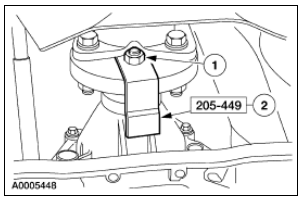


5. **NOTE:** The special tool contacts the flex coupling bolt sleeve to obtain an accurate reading.

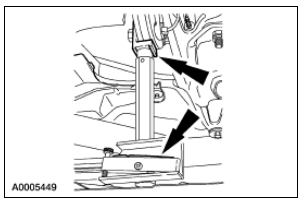
   NOTE: The bolt should never be removed, only the nut.

   Make preparations to measure the transmission angle (A) with respect to the frame rail.

1. Remove one of the nuts that attaches the flex coupling to the transmission flange.
2. Install the special tool onto the bolt on the rear of the flex coupling and tighten the nut.



6. Place the special tool in the bracket slot with the special tool facing the passenger side and record the reading.
    - Remove the special tools and tighten the fastener to specification. For additional information, refer to Section 205-01 .

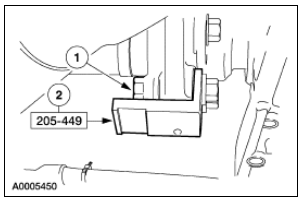


7. **NOTE:** The special tool must contact the flex coupling bolt sleeve to obtain an accurate reading.

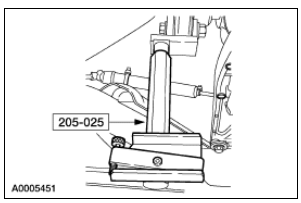
    NOTE: The bolt should never be removed, only the nut.

    Make preparations to measure the front driveshaft angle (B) with respect to the frame rail.

    1. Remove one of the nuts that attaches the flex coupling to the front driveshaft.
    2. Install the special tool onto the bolt on the front of the flex coupling and tighten the nut.



8. Place the special tool in the bracket slot with the special tool facing the passenger side and record the reading.
    - Remove the special tools and tighten the fastener to specification. For additional information, refer to Section 205-01 .



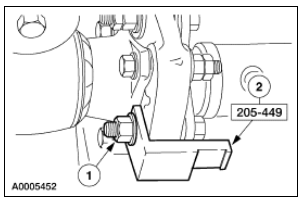
9. **NOTE:** The special tool must contact the flex coupling bolt sleeve to obtain an accurate reading.

    NOTE: The bolt should never be removed, only the nut.

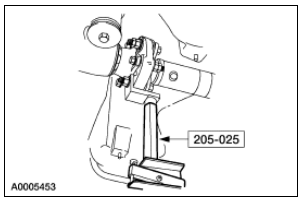
    Make preparations to measure the rear driveshaft angle (C) with respect to the frame rail.

    1. Remove one of the nuts that attaches the flex coupling to the rear driveshaft.

2. Install the special tool onto the bolt on the rear of the flex coupling and tighten the nut.



10. Place the special tool in the bracket slot with the special tool facing the passenger side and record the reading.
    - Remove the special tools and tighten the fastener to specification. For additional information, refer to Section 205-01 .

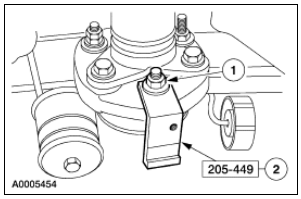


11. **NOTE:** The special tool must contact the flex coupling bolt sleeve to obtain an accurate reading.

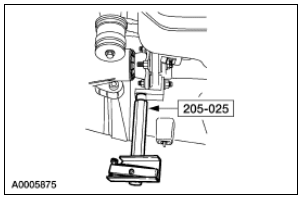
    NOTE: The bolt should never be removed, only the nut.

    Make preparations to measure the differential pinion angle (D) with respect to the frame rail.

    1. Remove one of the nuts that attaches the flex coupling to the pinion flange.
    2. Install the special tool onto the front of the flex coupling and tighten the nut.



12. Place the special tool in the bracket slot with the special tool facing the passenger side and record the reading.
    - Remove the special tools and tighten the fastener to specification. For additional information, refer to Section 205-01 .



13. Calculate the angles of joints 1, 2 and 3 as follows:
    - A - B = Joint 1
    - B - C = Joint 2
    - C - D = Joint 3

14. **NOTE:** To adjust the center support bearing adjusting washers, the exhaust heat shield must be removed.

NOTE: Left and right washers should be the same thickness.

NOTE: Two washers should not be assembled together.

Adjust the joint angles if necessary by varying the center support bearing adjusting washers.

Part Number	mm	Inch
W704775	2.0	0.079
W704776	3.0	0.118
W704777	4.0	0.157
W704778	5.0	0.20
W704779	6.0	0.24
W704780	7.0	0.28

15. Install the exhaust heat shield. For additional information, refer to Section 309-00 .

Torque Specifications

Description	Nm	lb-ft
Flex coupling bolts	81	60
Center bearing bolts	43	32

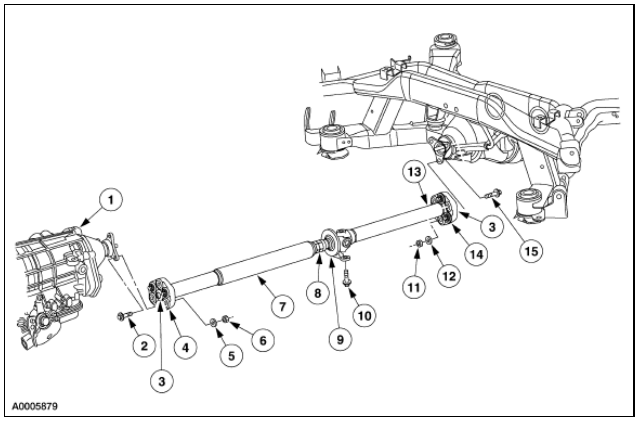
General Specifications

Item	Specification
Premium Long-Life Grease XG-1-C	ESA-M1C75-B
Threadlock 262 E2FZ-19554-B	WSK-M2G351-A6

Balance Nuts

Kit Part Number	Color	Weight (grams)
XW4Z-4613-AA	Red	1.23
	Silver	2.75
	Green	5.6
	Black	4.0

Driveshaft



Item	Part Number	Description
1	7000	Transmission
2	W705098-S301	Bolt
3	4635	Alignment bushing
4	4684	Flex coupling
5	W705019-S100	Washer
6	W705575-S301	Nut
7	4817	Shaft assembly, front
8	4N273	Nut, length adjustment
9	4A499	Center bearing and bracket assembly
10	N897487-S56	Bolt
11	W7055575-S301	Nut
12	W704773-S301	Washer
13	4602	Shaft assembly, rear
14	4684	Flex coupling
15	W704773	Bolt

⚠ CAUTION: All driveshaft assemblies (4602) are balanced. If undercoating the vehicle, protect the driveshaft to prevent overspray of any undercoating material.

The driveshaft is a two-piece design. A single center U-joint and a slip yoke connect the front shaft assembly (4817) and the rear shaft assembly (4602). The front and rear shaft assemblies are separable at the slip yoke. However, the slip yoke has no blind spline or index marks so it is imperative to index-mark the assemblies before separation to prevent an imbalance condition. The driveshaft uses new design flex couplings (4684) at each end of the shaft that takes the place of traditional U-joints. The driveshaft has alignment bushings (4635) at each end of the shaft. These bushings align the driveshaft with the pilot stems on the transmission flange and the axle pinion flange. Only remove the flex couplings from the driveshaft if it is necessary to install new flex couplings/alignment bushings. Always install new alignment bushings and flex couplings as a pair.

The driveshaft, has traditional balance weights attached (spot-welded) by the manufacturer. The final driveshaft balance occurs with the complete drivetrain assembly at vehicle assembly by attaching weighted color-coded nuts to the axle flex coupling bolts. For this reason, the rear flex coupling bolts are longer than the front transmission flex coupling bolts. Always install the driveshaft flex coupling bolts with the head of the bolt seated against the flange, and the nuts seated against the flex coupling.

To adjust the driveshaft angle, selective thickness spacers sit between the body and the center support-bearing bracket. Driveshaft angle specification is one degree or less. If the driveshaft angle is above one degree, damage to the alignment bushings and flex couplings will occur.

Universal Joints

The single center U-joint is:

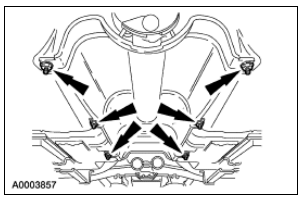
- a lubed-for-life design that requires no periodic lubrication.
- equipped with nylon thrust washers, located at the base of each bearing cup, which control end play, position the needle bearings and improve grease movement.
- staked to the yoke and not removable.

Driveshaft

Refer to Section 205-00 .

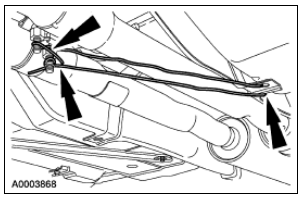
Driveshaft Runout and Balancing

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the bolts retaining the heat shield to the vehicle.



3. ⚠ **WARNING: Personal injury can result if the heat shield contacts the driveshaft during the balancing procedure. Secure the heat shield away from the driveshaft.**

   Move the heat shield forward and secure it with a wire.



4. Remove the rear wheel and tire assemblies. For additional information, refer to Section 204-04 .
5. ⚠ **WARNING: Reinstall and tighten the wheel nuts to prevent them from coming loose during the balancing procedure and causing personal injury.**

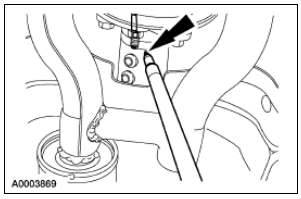
   Install and tighten the wheel nuts. For additional information, refer to Section 204-04 .
6. Lower the vehicle.
7. Open the hood to provide additional cooling.
8. Turn off the traction control, if so equipped.
9. Have an assistant get in the driver seat.
10. Raise the vehicle.
11. ⚠ **CAUTION: Do not exceed 70 mph.**

    Have the assistant accelerate to the speed where the imbalance is most noticeable.
12. ⚠ **WARNING: Keep hands, hair, head and clothing clear of rotating parts and hot exhaust components.**

    NOTE: The marker will contact the heavy side of the rotating driveshaft.

    Insert a suitable marker into a 305-mm (12-inch) long piece of plastic pipe. Using the heat shield lip as a brace, slowly move the scribe towards the driveshaft, in an area clear of the balance weld

weights, until it lightly contacts and marks the driveshaft.



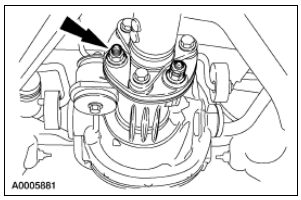
13. Have the assistant stop accelerating and shut off the engine.

14. With the driveshaft stationary, observe the mark on the driveshaft. A partial mark (less than 360 degrees) indicates the presence of an imbalance. A 360-degree mark indicates that there is no imbalance or that the pressure applied to the marker was too great. Proceed as follows if the mark indicates an imbalance. Otherwise, reinstall all components.

15. Locate the bolt in the flex coupling opposite the mark. Install a 1.23-gram (red) weighted nut onto this bolt. This is the light side of the driveshaft. Refer to the following chart for balance nut weight and color code information.

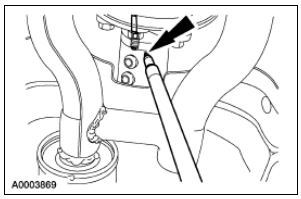
    Balance Nuts

Kit Part Number	Color	Weight (grams)
XW4Z-4613-AA	Red	1.23
	Silver	2.75
	Green	5.6
	Black	4.0



16. ⚠ **WARNING: Keep hands, hair, head and clothing clear of rotating parts and hot exhaust components.**

    Repeat the marking procedure Steps 12 and 13.

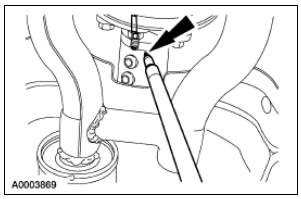


17. Have the assistant stop accelerating and shut off the engine.

18. With the driveshaft stationary, observe the mark on the driveshaft. If the new mark is 360 degrees, reinstall all components and road test the vehicle. If the vibration is still present, remove the 1.23-gram (red) weighted nut, install a 2.75-gram (silver) weighted nut in its place, and proceed as follows.

19. ⚠ **WARNING: Keep hands, hair, head and clothing clear of rotating parts and hot exhaust components.**

    Repeat the marking procedure Steps 12 and 13.

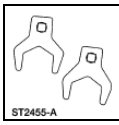


20. Have the assistant stop accelerating and shut off the engine.

21. With the driveshaft stationary, observe the mark on the driveshaft. If the new mark is 360 degrees, reinstall all components and road test the vehicle. If the vibration is reduced, move the weighted nut to the adjacent bolts and repeat the marking procedure. If the condition does not improve, install a new driveshaft assembly. Retest using the marker and weighted nuts as necessary. When the best possible condition is met, reinstall all components and road test the vehicle.

Driveshaft

Special Tool(s)

 ST2455-A	Torquing Wrenches, Driveshaft Coupler 205-474

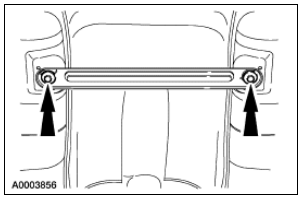
Removal

⚠ CAUTION: Only remove the flex couplings (4684) from the driveshaft (4602) if it is necessary to install new flex couplings/alignment bushings (4635). Install new alignment bushings and flex couplings as a pair. Balance the driveshaft with the flex couplings installed.

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. **⚠ WARNING: The normal operating temperature of the exhaust system is very high. Never attempt to remove any part of the system until it has cooled. Be especially careful when working around the catalytic converters. The temperature of the converter rises to a high level after only a few minutes of engine operation. Failure to follow these instructions can result in personal injury.**

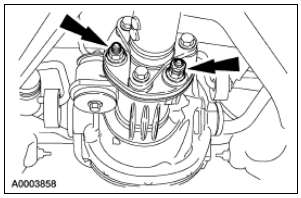
   ⚠ CAUTION: Do not allow the full weight of the exhaust to bear against the exhaust pipe manifold flanges. This will damage the flanges, and create exhaust leaks.

   Remove the muffler and extension pipe assembly. For additional information, refer to Section 309-00 .
3. Remove the body brace.


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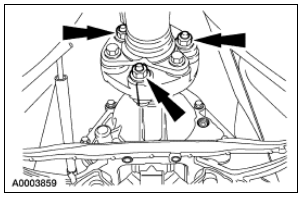
4. Remove the 8 retainers and the heat shield.
5. **⚠ CAUTION: To ensure assembly in the exact same location, index-mark the bolt, nut, washer, flex coupling and pinion flange with paint or marker. Using a different color paint or marker, index-mark the second bolt, nut and washer that retain the driveshaft and flex coupling to the pinion flange. Do not index-mark the third bolt, nut, and washer that retain the driveshaft and flex coupling to the pinion flange. These fasteners are balance weights. Always assemble them in their original positions. Failure to do so can cause driveshaft NVH.**

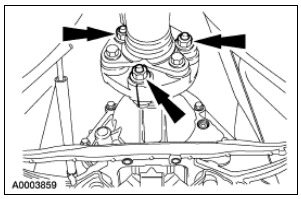
   Index-mark the components.



6. ⚠ **CAUTION: To ensure assembly in the exact same location, index-mark the bolt, nut, washer, flex coupling and transmission flange with paint or marker. Using a different color paint or marker, index-mark the second bolt, nut and washer that retain the driveshaft and flex coupling to the transmission flange. Do not index-mark the third bolt, nut, and washer that retain the driveshaft and flex coupling to the transmission flange. These fasteners are balance weights. Always assemble them in their original positions. Failure to do so can cause driveshaft NVH.**

   Index-mark the components.

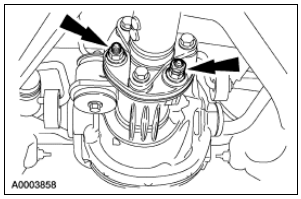




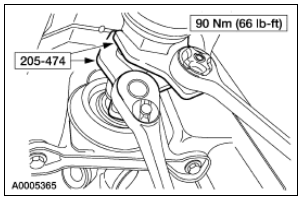
7. ⚠ **CAUTION: Do not remove the bolts retaining the flex coupling to the driveshaft.**

   NOTE: The bolt heads are serrated. Hold the bolt and loosen the nut.

   Remove the three nuts, washers and bolts.



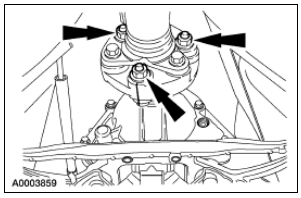
8. Using the special tools, loosen the nut.



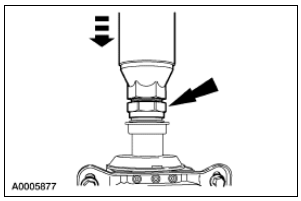
9. ⚠ **CAUTION: Do not remove the bolts retaining the flex coupling to the driveshaft.**

   NOTE: The bolt heads are serrated. Hold the bolt and loosen the nut.

   Remove the three nuts, washers and bolts.

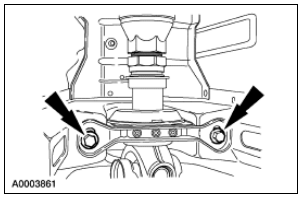


10. Slide the front shaft assembly rearward.
    - Tighten the nut to prevent separation of the front and rear shaft assemblies.



11. ⚠ **CAUTION: To ensure assembly in the exact same location, index-mark one bolt and the selective s pacer(s) with paint or marker. Do not index-mark the other bolt and the selective spacer(s) on the opposite end of the mount. These parts maintain the driveshaft driveline angle. Always assemble them in their original positions. Failure to do so can cause driveshaft NVH.**

    Remove the bolts and spacers, and the driveshaft assembly.

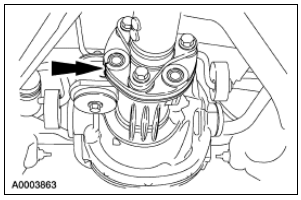


Installation

1. Add one gram of grease to both alignment bushing cavities.
    - Use Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.

2. ⚠ **CAUTION: Align the index marks or driveshaft NVH can occur.**

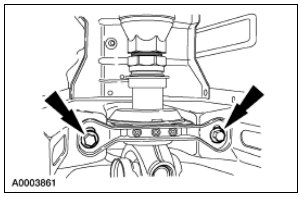
    Align the index marks, and position the alignment bushing on the pinion flange piloting stem.



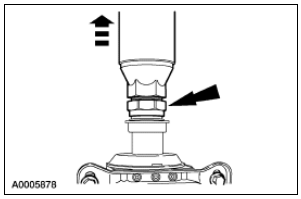
3. ⚠ **CAUTION: Install the selective spacers and bolts in their original positions.**

    NOTE: Do not tighten the bolts at this time.

    Install the spacers and the bolts hand tight.

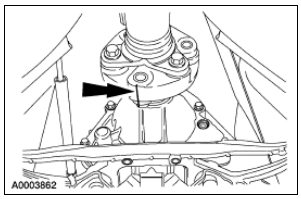


4. Loosen the nut and slide the front shaft assembly forward.



5. ⚠ **CAUTION: Align the index marks or driveshaft NVH can occur.**

   Align the index marks, and position the alignment bushing on the transmission flange piloting stem.

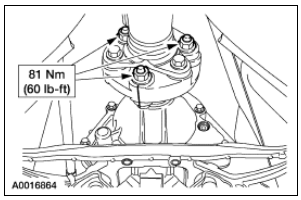


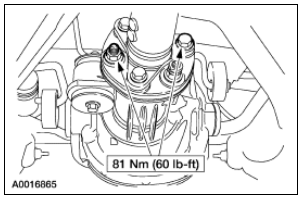
6. ⚠ **CAUTION: Install the bolts, washers and nuts in their original positions or driveshaft NVH can occur. Install the driveshaft flex coupling bolts with the head of the bolt seated against the flange, and the nuts seated against the flex coupling. Install the short bolts in the front and the long bolts in the rear.**

   NOTE: The bolt heads are serrated. Hold the bolt and tighten the nut.

   Install the bolts, washers and nuts.

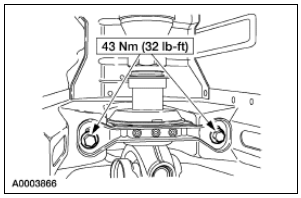
   - Coat the nut and bolt threads with Threadlock 262 E2FZ-19554-B or equivalent meeting Ford specification WSK-M2G351-A6.



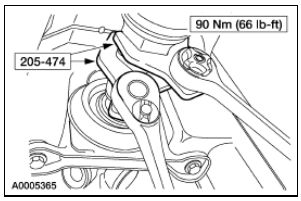


7. ⚠ **CAUTION: Tighten the bolts evenly to avoid twisting the bracket.**

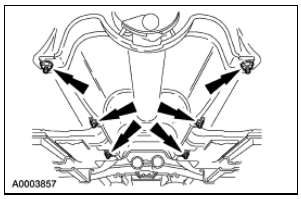
   Tighten the bolts.



8. Using the special tools, tighten the nut.



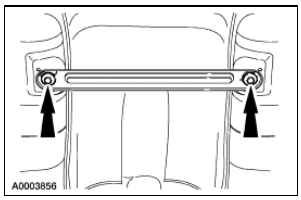
9. Install the heat shield.



10. **⚠ CAUTION: Do not allow the full weight of the exhaust to bear against the exhaust pipe manifold flanges. This will damage the flanges, and create exhaust leaks.**

    Install the muffler and extension pipe assembly. For additional information, refer to Section 309-00 .

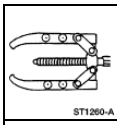
11. Install the body brace.



12. Lower the vehicle.

Driveshaft Center Bearing

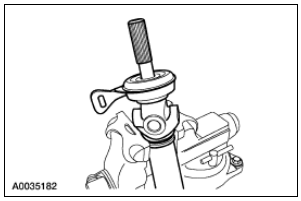
Special Tool(s)

 ST1260-A	2-Jaw Puller 205-D026 (D80L-1002-L) or Equivalent
 ST1368-A	Puller, Bearing 205-D064 (D84L-1123-A) or Equivalent
 ST2454-A	Driveshaft Alignment Bushing Remover Tube 205-D073 or Equivalent

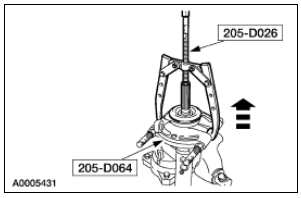
Disassembly

1. Remove the driveshaft (4602). For additional information, refer to Driveshaft in this section.
2. Separate the front and rear shaft assemblies.
3. ⚠ **CAUTION: Do not clamp on the driveshaft tube as a fracture can result.**

   Position and clamp the driveshaft at the weld yoke.

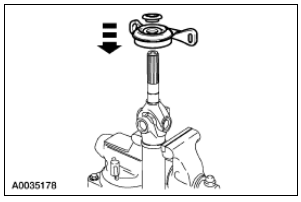


4. Using the special tools, remove the retaining ring and the center bearing and bracket assembly (4A499).

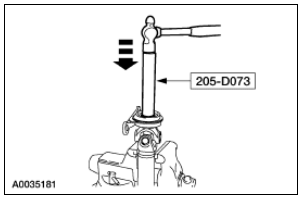


Assembly

1. Position the center bearing and bracket assembly and the retaining ring on the yoke.

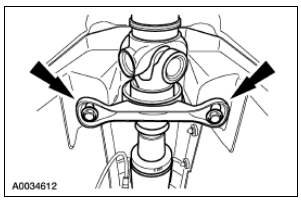


2. Using the special tool, drive the retaining ring and bearing assembly until fully seated on the yoke.



3. ⚠ **CAUTION: Align the index marks or driveshaft imbalance can occur.**

   Assemble the front and rear shaft assemblies.



4. Install the driveshaft. For additional information, refer to Driveshaft in this section.

Driveshaft Alignment Bushing

Special Tool(s)

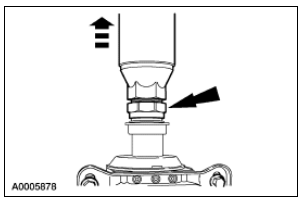
 ST1144-A	Blind Hole Puller Set 303-DS005 (D80L-100A) or Equivalent
 ST2454-A	Driveshaft Alignment Bushing Remover Tube 205-D073 or Equivalent
ST1255-A	Handle 205-153 (T80T-4000-W)
 ST1508-A	Driveshaft Alignment Bearing Installer 205-D074 or Equivalent

Disassembly

1. Remove the driveshaft (4602). For additional information, refer to Driveshaft in this section.

2. ⚠ **CAUTION: The slip yoke has no blind spline or index marks. Index-mark the assemblies before separation to prevent an imbalance condition.**

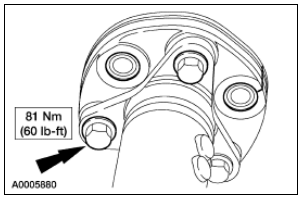
   Loosen the nut and separate the front (4817) and rear shaft (4602) assemblies.



3. **NOTE:** The bolt heads are serrated. Hold the bolt and loosen the nut.

   Remove the nuts and bolts and the flex coupling (4684).

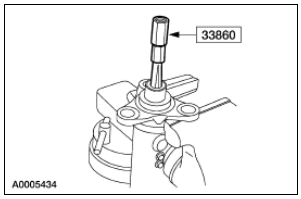
   - Discard the flex coupling. Retain the nuts and bolts.



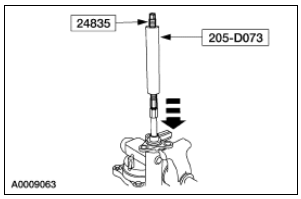
4. ⚠ **CAUTION: Do not clamp the vise on the driveshaft tube as a fracture can result.**

   Position the driveshaft end yoke in the vise jaws.

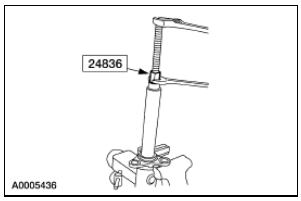
5. Insert the special tool inside the alignment bushing and expand the collet.



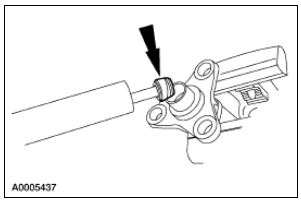
6. Install the special tools.



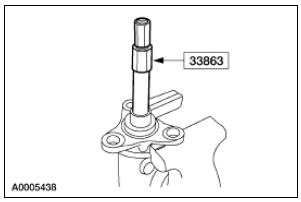
7. Hold the forcing screw, and tighten the forcing screw nut until removing the alignment bushing inner core.



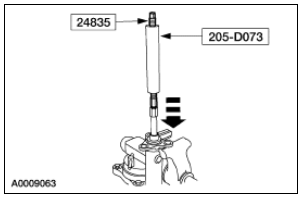
8. Discard the alignment bushing inner core.



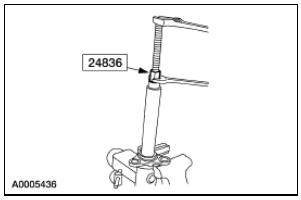
9. Insert the special tool and adjust it to seat behind the bushing shell.



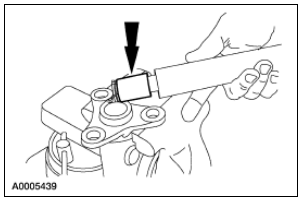
10. Install the special tools.



11. Hold the forcing screw, and tighten the forcing screw nut until removing the alignment bushing outer shell.



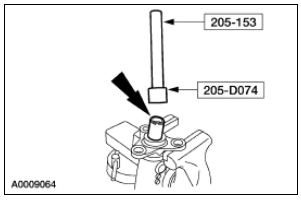
12. Discard the alignment bushing outer shell.



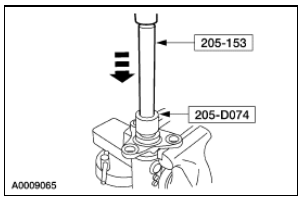
Assembly

1. **NOTE:** Install the alignment bushing (4635) with the seal facing outward.

   Using the special tools, align the bushing with the driveshaft.



2. Using the special tools, drive the alignment bushing until the tool contacts the end yoke.

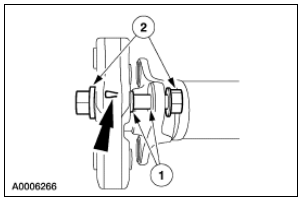


3. ⚠ **CAUTION: There are six bushings in each flex coupling. Three of the bushings protrude from one side of the flex coupling and three protrude from the other side. The arrows on the side of the flex coupling point toward the protruding end of the bushing. When installing the flex coupling, the protruding end of the bushing must seat in the driveshaft flange counterbore or damage will occur to the flex coupling during driveshaft operation.**

   Install the flex coupling.

   1. Position the protruding end of the bushing against the driveshaft flange.
   2. ⚠ **CAUTION: The bolt heads must seat against the driveshaft flange and the nuts against the flex coupling.**

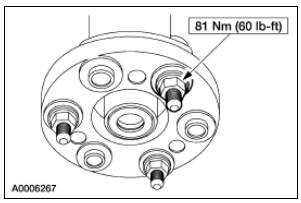
      Install the three bolts and nuts.



4. **NOTE:** The bolt heads are serrated. Hold the bolt and tighten the nut.

   Tighten the nuts.

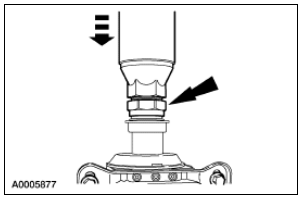
   - Coat the bolt threads with Threadlock 262 E2FZ-19554-B or equivalent meeting Ford specification WSK-M2G351-A6.



5. ⚠ **CAUTION: Align the index marks or driveshaft imbalance can occur.**

   Assemble the front and rear shaft assemblies.

   - Hand-tighten the nut to prevent separation of the front and rear shaft assemblies.



6. ⚠ **CAUTION: Add one gram of Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B to both alignment bushing cavities before installing the driveshaft.**

   Install the driveshaft (4602). For additional information, refer to Driveshaft in this section.

General Specifications

Description	mm	Inches
Clearance, Tolerance and Adjustments		
Maximum differential case runout	0.076	0.003
Maximum pinion stem runout	0.076	0.003
Backlash between ring gear teeth and pinion teeth	0.127-0.228	0.005-0.009
Maximum backlash variation between teeth	0.076	0.003
Available drive pinion bearing adjustment shim in steps of: 0.0254 mm (0.001 inch) 8.8-inch axle	0.254-0.965	0.010-0.038
Maximum housing spread	0.762	0.030
Carrier bearing preload shim	0.152	0.006
Carrier bearing LH shim	6.73	0.265

Lubricant Capacities

Liters	Pints
1.4	3.0 [a]

[a] Use SAE 75W-140 Synthetic Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A. Fill the rear axle 3-5 mm (1/8-3/16 inch) from the bottom of filler hole.

General Specifications

Item	Specification
Lubricants/Sealants	
Premium Long-Life Grease XG-1-C	ESA-M1C75-B
Threadlock® and Sealer E0AZ-19554-AA	WSK-M2G351-A5
SAE 75W-140 Synthetic Rear Axle Lubricant F1TZ-19580-B	WSL-M2C192-A
Silicone Rubber D6AZ-19562-AA	ESB-M4G92-A
Stud and Bearing Mount E0AZ-19554-BA	WSK-M2G349-A1
Pipe Sealant with Teflon® D8AZ-19554-A	WSK-M2G350-A2
SAE 5W-30 Super Premium Motor Oil XO-5W30-QSP	WSS-M2C153-G

Torque Specifications

Description	Nm	lb-ft	lb-in

Bearing cap bolt	105	77	
Differential pinion shaft lock bolt	30	22	
Ring gear bolt [a]	105	77	
Differential housing cover retaining bolt	32	24	
Filler plug	34	25	
Rear differential front lower insulator nut	70	52	
Rear axle differential front lower insulator nuts and bolts	70	52	
Rear axle differential rear insulator bolt	103	76	
Pinion bearing preload (drive pinion collapsible spacer) used bearings [b]	0.9-1.6		8-15
new bearings	1.8-3.2		16-29
Driveshaft adjuster nut	90	66	

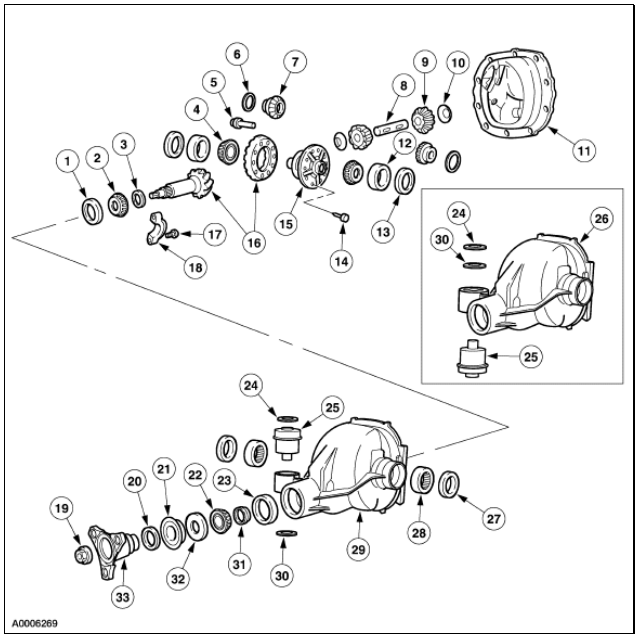
[a] Use Stud and Bearing Mount E0AZ-19554-BA or equivalent meeting Ford specification WSK-M2G349-A1.
[b] With pinion flange yoke seal.

Rear Drive Axle and Differential

The rear axle assembly contains the following features:

- integral-type housing hypoid gear design has the centerline of pinion set below the centerline of ring gear.
- hypoid ring gear and pinion which consists of a 203-mm (8.0-inch) diameter ring gear and an overhung drive pinion which is supported by two opposed tapered roller bearings.
- pinion bearing preload is maintained by a drive pinion collapsible spacer on the pinion shaft and adjusted by the pinion nut.
- rear axle housing (4010) assembly which consists of a cast aluminum center section and a cast-aluminum rear differential housing cover (4033).
- differential housing cover which uses a silicone sealant rather than a gasket.
- aluminum rear axle housing that must be spread in order to remove the differential case (4204).
- differential case which is a one-piece design with two openings to allow for assembly of internal components and lubricant flow.
- differential pinion shaft (4211) which is retained by a threaded differential pinion shaft lock bolt assembled to the differential case.
- differential case which is mounted in the rear axle housing between two opposed differential bearings (4221).
- differential bearings which are retained in the rear axle housing by removable bearing caps.
- differential bearing preload and ring gear backlash are adjusted by differential bearing shims (4067) located between the differential bearing cup (4222) and the rear axle housing.
- the use of a pinion depth gauge is required for correct differential ring gear and pinion adjustment.
- the halfshafts are held in the differential case by a driveshaft bearing retainer circlip (3Z498) that is located on the inboard CV joint stub shaft pilot bearing housing (4B413). When each halfshaft is installed, the driveshaft bearing retainer circlip engages a step in the differential side gear (4236).

Rear Axle-8.0-Inch Ring Gear



Item	Part Number	Description
1	4628	Rear axle pinion bearing cup

2	4630	Pinion bearing
3	4663	Drive pinion bearing adjustment shim
4	4221	Differential bearing
5	4241	Differential pinion shaft lock bolt
6	4228	Differential side gear thrust washer
7	4236	Differential side gear
8	4211	Differential pinion shaft
9	4215	Differential pinion gear
10	4230	Differential pinion thrust washer
11	4033	Differential housing cover
12	4222	Differential bearing cup
13	4067	Differential bearing shim
14	4216	Rear axle ring gear case bolt
15	4204	Differential case
16	4209	Ring gear and pinion
17	56187-S	Bolt
18		Differential bearing cap (part of 4010)
19	389546-S100	Pinion nut
20	4859	Drive pinion oil seal deflector
21	4676	Rear axle drive pinion seal
22	4621	Pinion bearing
23	4616	Differential drive pinion bearing cup
24	4067	Front mount shim
25	4B424	Rear axle differential front lower insulator
26	4010	Rear axle housing (aluminum)
27	4B416	Inboard CV joint stub shaft pilot bearing housing seal
28	4B413	Inboard CV joint stub shaft pilot bearing housing
29	4010	Rear axle housing (nodular iron)
30	4B431	Rear axle differential front lower insulator cap
31	4662	Differential drive pinion collapsible spacer
32	4670	Rear axle drive pinion shaft oil slinger
33	4851	Rear axle pinion flange

The rear drive axle operates as follows:

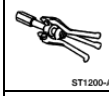
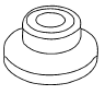
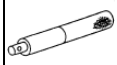
- The rear axle drive pinion receives power from the engine through the transmission and driveshaft (4602).
- The pinion gear rotates the differential case when engaged with the ring gear, which is bolted to the differential case outer flange.
- Inside the differential case, two differential pinion gears (4215) are mounted on a differential pinion shaft which is pinned to the differential case.
- These differential pinion gears are engaged with the differential side gears to which the halfshafts are splined.
- As the differential case turns, it rotates the halfshafts and rear wheels.
- When it is necessary for one wheel and halfshaft to rotate faster than the other, the faster turning differential side gear causes the differential pinion gears to roll on the slower turning differential side gear. This allows differential action between the two halfshafts.

Rear Drive Axle and Differential

Refer to Section 205-00 .

Stub Shaft Pilot Bearing and Seal

Special Tool(s)

 ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)
 ST2258-A	Protector, Halfshaft Seal 205-506
 ST1676-A	Installer, Halfshaft Seal 205-505
 ST1326-A	Adapter for 303-224 (Handle) 205-153 (T80T-4000-W)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1721-A	Installer, Halfshaft Pilot Bearing 205-504

Material

Item	Specification
SAE 75W-140 Synthetic Rear Axle Lubricant XY-75W140-QL	WSL-M2C192-A
Premium Long Life Grease XG-1-C	ESA-M1C75-B

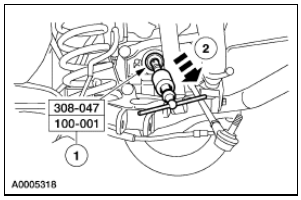
Removal

1. Remove the halfshaft assembly. For additional information, refer to Section 205-05 .

2. **NOTE:** If only a new inboard CV joint stub shaft pilot bearing housing seal is to be installed, engage the bearing cup puller tangs on the inboard CV joint stub shaft pilot bearing housing seal.

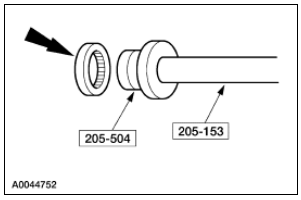
   Remove the inboard CV joint stub shaft pilot bearing housing seal and inboard CV joint stub shaft pilot bearing.

   1. Install the special tools with the tangs firmly engaged on the inboard CV joint stub shaft pilot bearing housing.
   2. Remove the inboard CV joint stub shaft pilot bearing housing seal and inboard CV joint stub shaft pilot bearing.

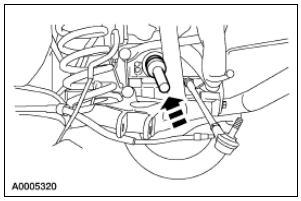


Installation

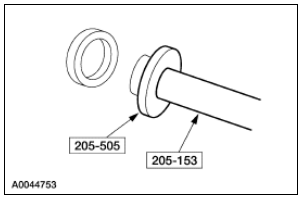
1. Lubricate the new inboard CV joint stub shaft pilot bearing with rear axle lubricant. Place the inboard CV joint stub shaft pilot bearing onto the special tools.



2. Install the inboard CV joint stub shaft pilot bearing into the rear axle housing bore.

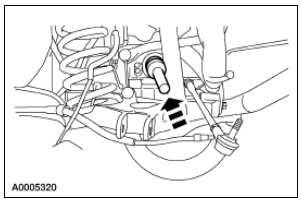


3. Lubricate the lip of the inboard CV joint stub shaft pilot bearing housing seal with long life grease. Place the inboard CV joint stub shaft pilot bearing housing seal onto the special tools.



4. ⚠ **CAUTION: Installation of the inboard CV joint stub shaft pilot bearing housing seal or inboard CV joint stub shaft pilot bearing without the correct tool can result in an early inboard CV joint stub shaft pilot bearing housing seal or pilot bearing failure. If the inboard CV joint stub shaft pilot bearing becomes cocked in the bore during installation, remove it and install a new one.**

   Carefully align the inboard CV joint stub shaft pilot bearing housing seal with the housing bore and install the inboard CV joint stub shaft pilot bearing housing seal.



5. ⚠ **CAUTION: Use special tool 205-506 to avoid damaging the seal with CV joint stub shaft.**

   ⚠ **CAUTION: Inspect the inboard CV joint seal journal for rust or nicks/scratches prior to**

installing the halfshaft. Polish the seal journal with fine crocus cloth, if required.

Install the halfshaft. For additional information, refer to Section 205-05 .

Drive Pinion Flange and Drive Pinion Seal

Special Tool(s)

 ST2458-B	Holding Tool, Drive Pinion Flange 205-478
 ST1734-A	Installer, Drive Pinion Flange 205-479
 ST2452-A	Remover, Output Flange 307-408
 ST1325-A	Installer, Drive Pinion Oil Seal 205-208 (T83T-4676-A)

Removal

1. ⚠ **CAUTION: Do not allow the calipers to hang from the brake hoses.**

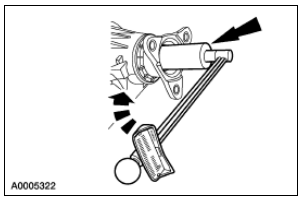
   NOTE: Remove the rear wheels and the brake calipers to prevent drag during the drive pinion bearing preload adjustment.

   Remove and secure the rear brake calipers aside. For additional information, refer to Section 206-04 .

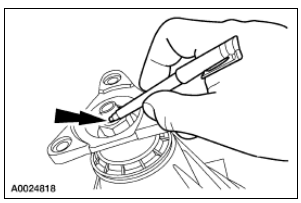
2. ⚠ **CAUTION: Do not disconnect the driveshaft before referring to Section 205-01 .**

   Remove the driveshaft assembly. For additional information, refer to Section 205-01 .

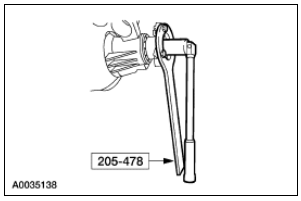
3. Install a Nm (inch-pound) torque wrench on the pinion nut and record the torque necessary to maintain rotation of the drive pinion gear through several revolutions.


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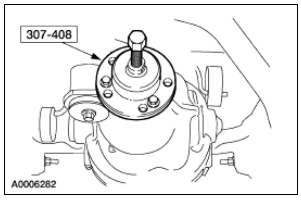
4. Mark the pinion flange in relation to the drive pinion stem to make sure of correct alignment during installation.


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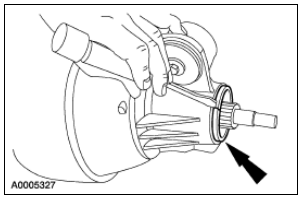
5. Remove and discard the pinion nut.
    - Install the special tool.
    - Install a suitable breaker bar and remove the nut.



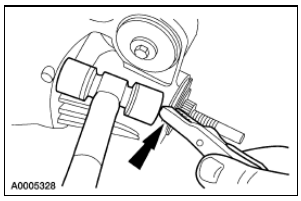
6. Using the special tool, remove the pinion flange.



7. Force up the metal flange of the rear axle drive pinion seal (4676).



8. Clamp and strike the locking pliers with a hammer to remove the rear axle drive pinion seal.



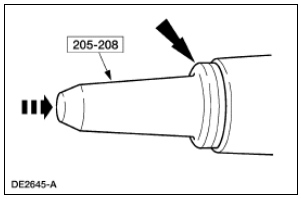
Installation

1. Lubricate the lips of the new rear axle drive pinion seal.
    - Use Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B.

2. ⚠ **CAUTION: Installation without the correct tool can result in early seal failure.**

    ⚠ **CAUTION: If the rear axle drive pinion seal becomes misaligned during installation, remove it and install a new one.**

    Using the special tool, install the rear axle drive pinion seal.



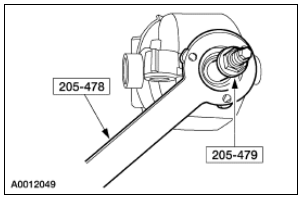
3. Lubricate the pinion flange splines.
    - Use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.

4. ⚠ **CAUTION: Inspect the pinion flange seal journal for rust or nicks/scratches prior to installing the pinion flange. Polish the seal journal with fine crocus cloth, if required.**

   NOTE: Disregard the alignment marks if installing a new pinion flange.

   Align the pinion flange with the drive pinion shaft.

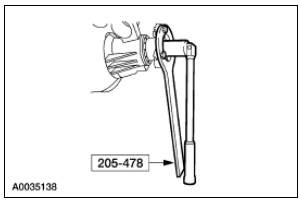
5. Using the special tools, install the pinion flange.



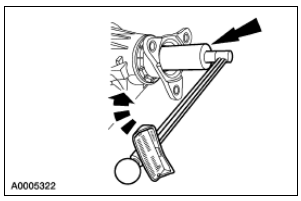
6. ⚠ **CAUTION: Do not under any circumstance loosen the pinion nut to reduce preload. If it is necessary to reduce preload, install a new collapsible spacer and pinion nut.**

   Use the special tool to hold the pinion flange while tightening the new pinion nut.

    - Rotate the pinion occasionally to make sure the differential pinion bearings seat correctly. Take frequent differential pinion bearing torque preload readings by rotating the pinion with a Nm (inch-pound) torque wrench.



7. If the preload recorded prior to disassembly is lower than the specifications for used bearings, tighten the pinion nut to specifications. If the preload recorded prior to disassembly is higher than the specifications for used bearings, tighten the pinion nut to the original reading as recorded.
    - Refer to the torque specification for pinion bearings in the Specifications portion of this section.



8. Connect the driveshaft. For additional information, refer to Section 205-01 .

9. Install the rear brake calipers. For additional information, refer to Section 206-04 .

10. Install the rear wheel and tire assemblies. For additional information, refer to Section 204-04 .

Axle Housing

Special Tool(s)

 ST2455-A	Torquing Wrench, Driveshaft Coupler (Pair) 205-474

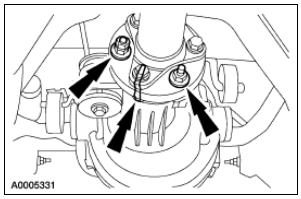
Removal and Installation

1. Remove the halfshafts. For additional information, refer to Section 205-05 .

2. Remove the heat shield underbody. For additional information, refer to Section 309-00 .

3. ⚠ **CAUTION: The driveshaft-to-pinion flange bolts, nuts and weighted nuts must be installed in the same locations from which they were removed.**

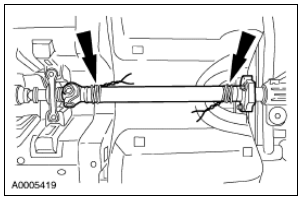
   Mark the pinion flange, the driveshaft flexible coupling and each of the three driveshaft-to-pinion flange bolts, nuts and weighted nuts with different color paint so that the driveshaft and differential may be realigned during installation.


A0005331

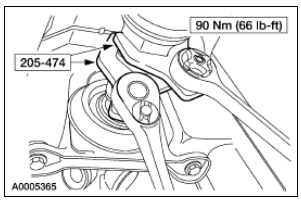
4. ⚠ **CAUTION: Do not remove the flex coupling on the driveshaft flange. Make sure to remove only the driveshaft-to-pinion flange bolts and nuts.**

   Remove the three driveshaft-to-pinion flange bolts and nuts.

5. Support the driveshaft at the center and rear.


A0005419

6. Loosen the driveshaft yoke adjuster nut.

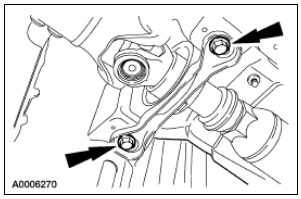


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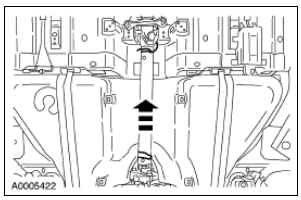
7. **NOTE:** There are shims between the center bearing mounting bracket and the body.

NOTE: The shims must be installed in their original locations.

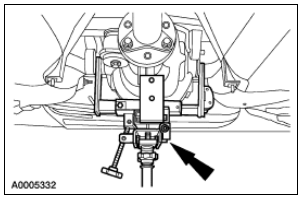
Remove the bolts and the shims.



8. Slide the rear driveshaft to the full forward position and tighten the adjuster nut.

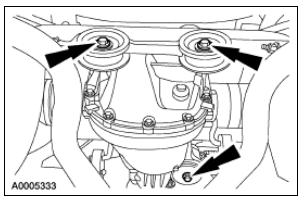


9. Position a suitable jack under the axle housing.



10. **NOTE:** The front mount has a nut and shim on the top.

    Remove the three mounting bolts.



11. Lower the axle housing assembly from the vehicle.

12. To install, reverse the removal procedure.
    - Make sure to position the shim on the front mount before raising the axle housing into position.

Axle Housing Bushing

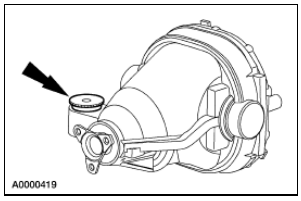
Special Tool(s)

 ST2543-A	Remover/Installer, Differential Bushings 205-485

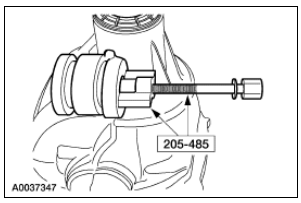
Removal

1. Remove the axle housing assembly from the vehicle. For additional information, refer to Axle Housing in this section.

2. Remove the rear axle differential front upper insulator.


A0000419

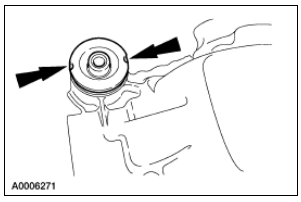
3. Using a hammer and the special tools, remove the rear axle differential front lower insulator.



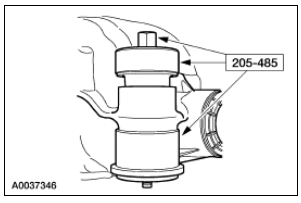
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Installation

1. Insert the rear axle differential front lower insulator and make sure that the notches are aligned forward and aft.

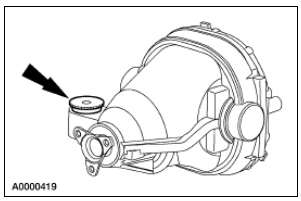

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2. Using the special tools, install the rear axle differential front lower insulator.



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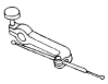
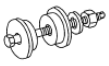
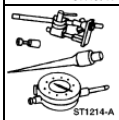
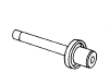
3. Install the rear axle differential front upper insulator.

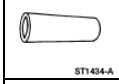
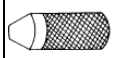
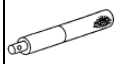
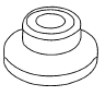
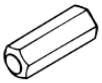


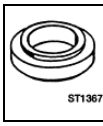
4. Install the rear axle housing. For additional information, refer to Axle Housing in this section.

Axle Aluminum

Special Tool(s)

 ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or equivalent
 ST1165-A	Preload Gauge, Bearing 205-S337 (T93P-4220-AR)
 ST1348-A	Gauge, Clutch Housing 308-021 (T75L-4201-A)
 ST1678-A	Installer, Drive Pinion Bearing Cup 205-054 (T71P-4616-A)
 ST1183-A	Dial Indicator Gauge 100-D005 (D78P-4201-G) or equivalent
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST1259-A	Spreader, Differential Carrier 205-001 (TOOL-4000-E) or equivalent
 ST1375-A	Installer, Differential Side Bearing 205-010 (T57L-4221-A2)
 ST2458-B	Holding Tool, Drive Pinion Flange 205-478
 ST2452-A	Remover, Output Flange 307-408
 ST1743-A	Depth Gauge/Aligner, Depth Pinion 205-477
 ST1431-A	Adapter for 205-S127 205-110 (T76P-4020-A10)
 ST1743-A	Depth Gauge, Drive Pinion 205-476

 ST1434-A	Gauge Tube, Drive Pinion 205-336 (T93P-4020-A)
 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 ST1326-A	Adapter for 303-224 (Handle) 205 153 (T80T-4000 W)
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST1344-A	Spreader, Differential Housing (Plate) 205-335 (T93P-4000-A)
 ST1676-A	Installer, Drive Pinion Inner Bearing Cup 205-480
 ST1349-A	Gauge, Differential Bearing 205-338 (T93P-4222-A)
 ST1310-A	Remover, Bearing 205-055 (T71P-4621-B)
 ST1734-A	Installer, Drive Pinion Flange 205-479
 ST1744-A	Protector, Drive Pinion Thread 205-460
 ST2320-A	Remover, Drive Pinion Inner Bearing Cup 205-481
 ST2320-A	Remover, Drive Pinion Outer Bearing Cup 205-482
 ST1350-A	Gauge, Differential Bearing 205-339 (T93P-4222-B)
ST1429-A	Adapter for 205-S127 205-109 (T76P-4020-A9)
 ST1254-A	Plate, Bearing/Oil Seal 205-090 (T75L-1165-B)
 ST1725-A	Step Plate 205-D061 (D83T-4205-C2) or equivalent

 ST1367-A	Installer, Drive Pinion Bearing Cone 205-005 (T53T-4621-C)

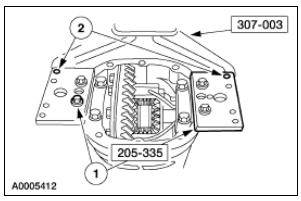
Disassembly

1. Remove the differential housing cover.

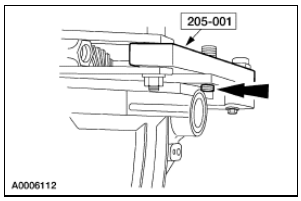
2. ⚠ **CAUTION: Extreme care must be taken not to damage aluminum rear axle housing (4010) while carrying out these procedures.**

   Mount the rear axle housing on the Transmission Holding Fixture.

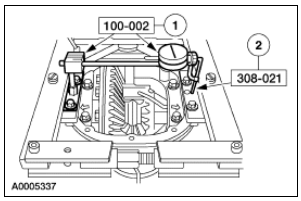
   1. Attach the special tools to the rear axle housing with four cover bolts.
   2. Attach the Differential Housing (Plates) Spreader to the Transmission Holding Fixture with two 3/8 inch x 1-1/2 inch bolts.



3. Install the Differential Carrier Spreader onto the Differential Housing (Plates) Spreader Adapters with the spreader pins aligned with the holes in the Housing Spreader Adapters.



4. Assemble the special tools.
   1. Install the Dial Indicator Gauge.
   2. Attach the Clutch Housing Gauge Adapter to the Dial Indicator Gauge with the tip positioned in the spreader adapter hole.

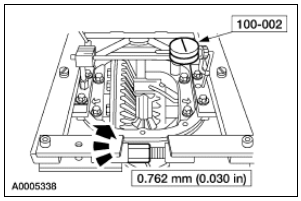


5. ⚠ **CAUTION: Overspreading can damage the rear axle housing.**

   NOTE: Tighten and loosen the housing spreader adapter screw to normalize the Differential Housing (Plates) Spreader prior to the final Dial Indicator Gauge reading.

   Adjust the dial indicator to zero and tighten the housing spreader screw until the rear axle housing is spread to specification.

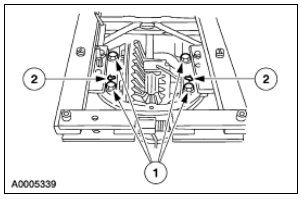
   - Remove the Dial Indicator Gauge.



6. **NOTE:** Mark the position of the bearing caps as arrows may not be visible. The bearing caps must be installed in their identical locations and positions.

   Remove the differential bearing caps.

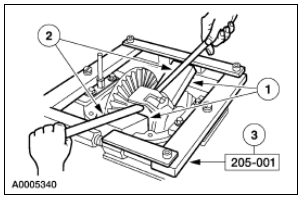
   1. Remove the bearing cap retaining bolts.
   2. Remove the differential bearing caps.



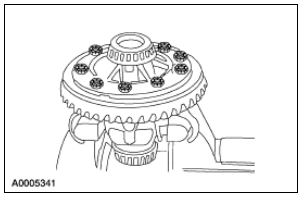
7. ⚠ **CAUTION: Wood blocks must be used to avoid rear axle housing damage.**

   Remove the differential case (4204).

   1. Position wood blocks on top and bottom of the differential (4026).
   2. Pry the differential case and the differential bearing shims (4067) out of the rear axle housing.
   3. Remove the special tool.

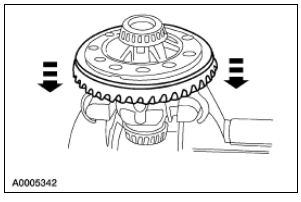


8. Remove the 10 ring gear bolts.



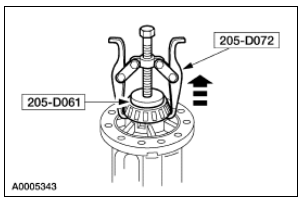
9. ⚠ **CAUTION: Care should be taken not to damage the bolt hole threads.**

   Insert a punch in the bolt holes and drive the ring gear off.

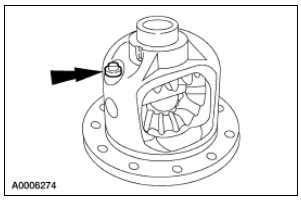


10. Using the special tools, remove the differential bearing (4221).

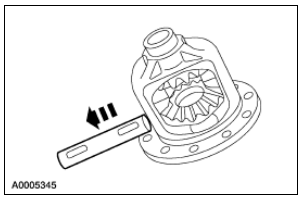
- Repeat for the other side.



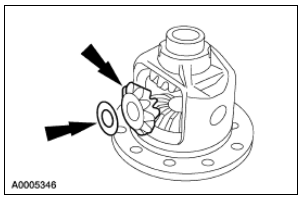
11. Remove the differential pinion shaft lock bolt.



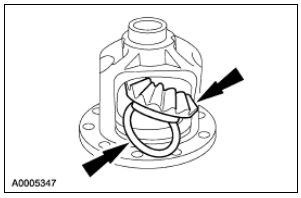
12. Remove the differential pinion shaft.



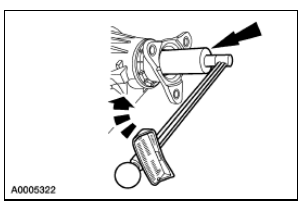
13. Remove the differential gears.



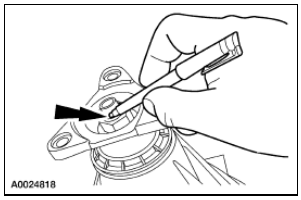
14. Remove the differential side gears.



15. Install a Nm (inch/pound) torque wrench on the pinion nut and record the torque necessary to maintain rotation of the drive pinion gear (4209) through several revolutions.



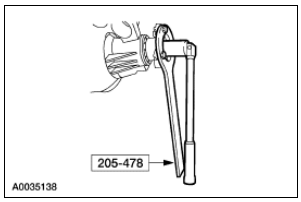
16. Mark the pinion flange in relation to the drive pinion stem to make sure of correct alignment during installation.



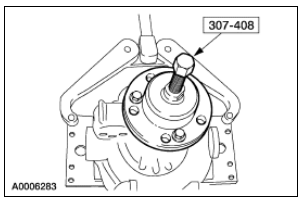
17. ⚠ **CAUTION: After removing the pinion nut, discard it. Use a new nut for installation.**

    Remove the pinion nut.

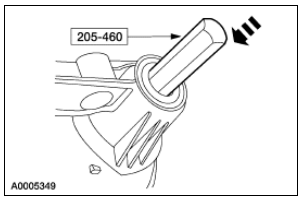
    - Install the special tool.
    - Install a suitable breaker bar and remove the nut.



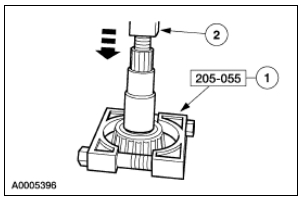
18. Using the special tool, remove the pinion flange.



19. Install the special tool and, with a soft-faced hammer, drive the pinion out of the front bearing cone and remove it through the rear of the housing.
    - Remove the rear axle drive pinion shaft oil slinger (4670), the rear axle drive pinion seal (4676) and the collapsible spacer.

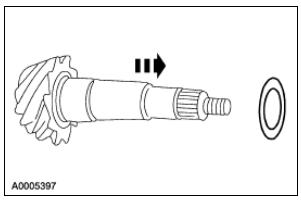


20. Remove the front pinion bearing.
    1. Position the special tool under the pinion bearing.
    2. Using a press, remove the pinion bearing.

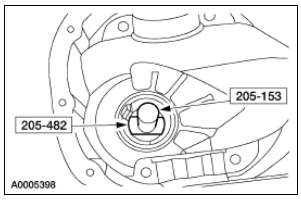


21. **NOTE:** Measure the drive pinion bearing adjustment shim (4663), which is found under the differential pinion bearing, with a micrometer and record the thickness. (Use this as a reference to compare the shim gauge reading prior to installing the differential pinion bearing.)

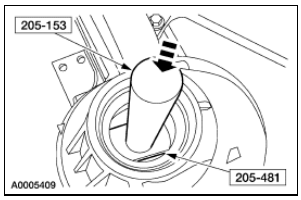
Remove the drive pinion bearing adjustment shim.



22. If required, remove damaged rear axle pinion bearing cup (4616) from the rear axle housing using the special tools.



23. If required, remove rear axle pinion bearing cup (4628) from the rear axle housing using the special tools.

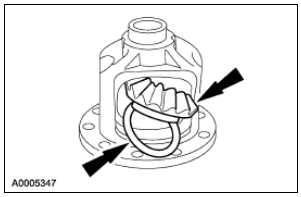


Assembly

All vehicles

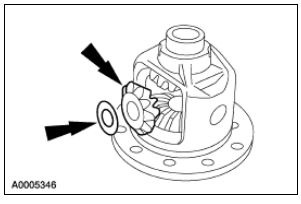
1. ⚠ **CAUTION: Lubricate the differential side gear thrust washers with Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B prior to installation.**

   Install the differential side gears in the differential case.



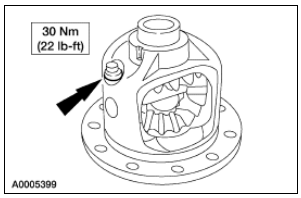
2. ⚠ **CAUTION: Lubricate the differential pinion thrust washers with Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B prior to installation.**

   Install the differential pinion gears with the differential pinion thrust washers in the differential case.

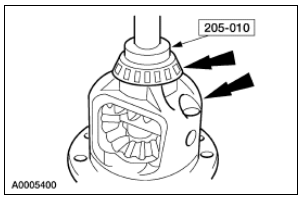


3. **NOTE:** If a new pinion shaft lock bolt is unavailable, coat the threads with Threadlock® and Sealer E0AZ-19554-AA or equivalent meeting Ford specifications WSK-M2G351-A5 prior to installation.

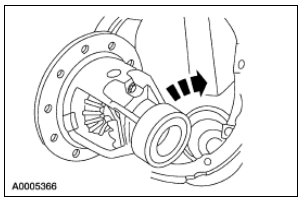
   Install the differential pinion shaft and install a new differential pinion shaft lock bolt.



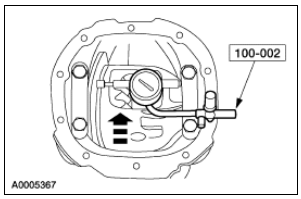
4. Use the special tool to install the differential bearing on the differential case. Repeat for the other side.



5. Install the differential case without the ring gear.
   - Rotate the differential case to correctly seat the differential bearings.

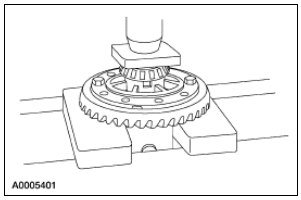


6. Check the differential case flange runout using the special tool.
   - If the runout is within specification, install a new ring gear and pinion. If the runout exceeds specification, the ring gear is true and the concern is due to either a damaged differential case or differential bearings.
   - Inspect the differential bearings. If the differential bearings are not damaged, install a new differential case and the differential bearings.
   - Recheck the runout with the new differential case and differential bearings.

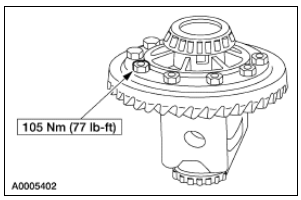


7. Remove the differential case.

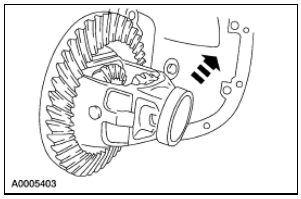
8. Press the ring gear on the differential case.
   - Start two of the ring gear bolts through the differential case and into the ring gear to make sure the ring gear bolt holes align with the differential case bolt holes correctly.



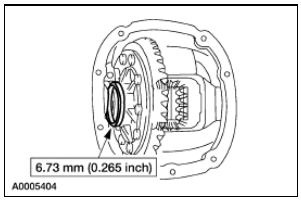
9. Install the ring gear bolts.
    - Apply Stud and Bearing Mount E0AZ-19554-BA or equivalent meeting Ford specification WSK-M2G349-A1 to the ring gear bolts.



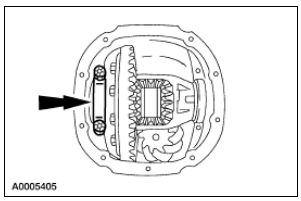
10. With the pinion removed, place the differential case/gear subassembly with the differential bearing and the rear axle pinion bearing cups in the rear axle housing.



11. Install a differential bearing shim of the thickness shown on the LH side of the differential case.

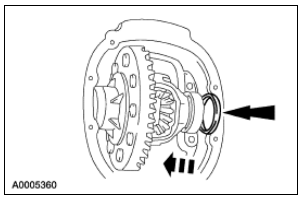


12. Install the LH bearing cap finger-tight.

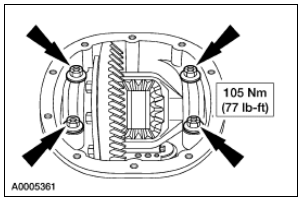


13. **NOTE:** Apply pressure toward the left side to fully seat the differential bearing cup (4222).

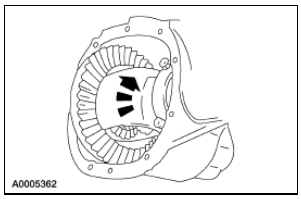
    Install progressively larger differential bearing shims on the RH side until the largest differential bearing shim selected can be assembled with a slight drag feel.



14. Install the RH bearing cap.
    - Tighten both bearing caps to specification.

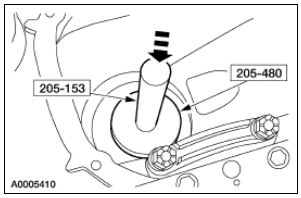


15. Rotate the differential assembly to make sure it rotates freely.

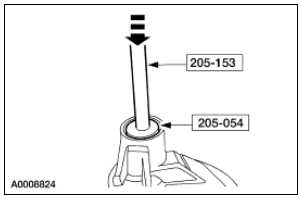


Pinion bearing cup installation with special tools 205-153, 205-480, and 205-054

16. Install a new inner rear axle pinion bearing cup in the rear axle housing.



17. Install a new outer rear axle pinion bearing cup in the rear axle housing.

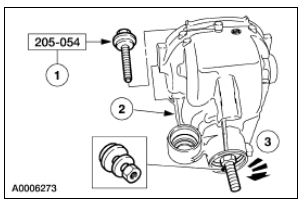


Pinion bearing cup installation with special tool 205-054

18. **NOTE:** Coat the new rear axle pinion bearing cup with SAE 5W-30 Super Premium Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

    Install the pinion bearing cup.

    1. Position the rear axle pinion bearing cup on the special tool.
    2. Position the bearing cup replacer in the rear axle housing.
    3. Tighten the special tool to fully seat the rear axle pinion bearing cup in the bore.



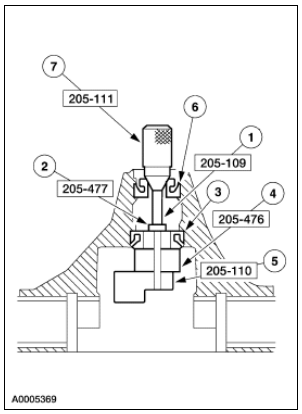
All vehicles

19. **NOTE:** A drive pinion bearing adjustment shim is used between the pinion bearing and the pinion

head. The drive pinion bearing adjustment shim compensates for machining variations in the differential pinion and the pinion bearings. The correct drive pinion bearing adjustment shim size will locate the pinion for correct tooth contact with the ring gear. Selecting the correct drive pinion bearing adjustment shim can be done using a pinion depth gauge set.

NOTE: Apply a light film of SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A on the front differential pinion bearing and the rear differential pinion bearing assemblies.

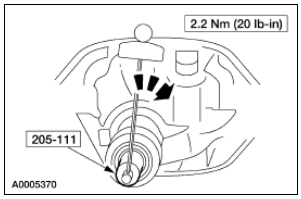
Install the special tools.



Item	Part Number	Description
1	205-109	Adapter for 205-S127 (T76P-4020-A9)
2	205-477	Gauge aligner, depth pinion
3	4630	Rear (inner) pinion bearing
4	205-476	Gauge disc, drive pinion
5	205-110	Gauge block (1.7 inch thick) (T76P-4020-A10)
6	4621	Front (outer) pinion bearing
7	205-111	Adapter for 205-S127 (T76P-4020-A11)

20. **NOTE:** This step duplicates pinion bearing preload.

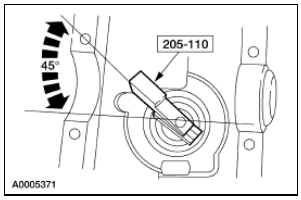
    Thread the Handle onto the Screw and tighten to the specification shown.



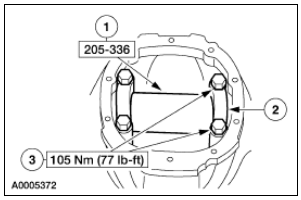
21. **NOTE:** The special tool must be offset to obtain an accurate reading.

    NOTE: Rotate the special tool several half turns to correctly seat the pinion bearings.

    Position the special tool 45 degrees as shown.



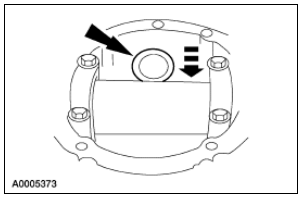
22. Install the special tool.
    1. Position the special tool on the differential bearing seat of the rear axle housing.
    2. Install the differential bearing caps.
    3. Install the differential bearing cap bolts and tighten to specification.



23. **NOTE:** A slight drag should be felt for the correct shim selection.

    NOTE: Use a shim to determine shim thickness.

    Select and check the correct shim size.

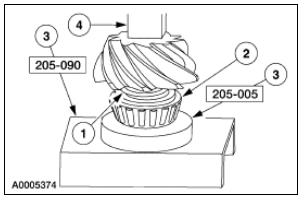


24. Remove the special tool.

25. **NOTE:** The same pinion bearings and drive pinion bearing adjustment shim used in the drive pinion shim selection procedure must be used in the final axle assembly.

    Install the rear pinion bearing.

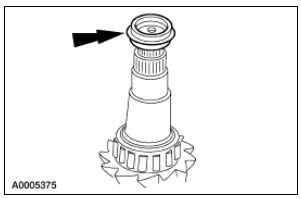
    1. Position the drive pinion bearing adjustment shim on the pinion stem.
    2. Position the pinion bearing on the pinion stem.
    3. Position the special tool on the pinion stem.
    4. Using a press, firmly seat the drive pinion bearing adjustment shim and pinion bearing on the pinion stem.



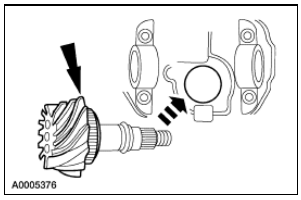
26. Install the front pinion bearing, the rear axle drive pinion shaft oil slinger and the rear axle drive pinion seal in the differential housing.

27. **NOTE:** Make sure the splines on the pinion stem are free of burrs. If burrs are evident, remove using a fine crocus cloth, working in a rotational motion.

Place a new drive pinion collapsible spacer on the pinion stem against the pinion stem shoulder.



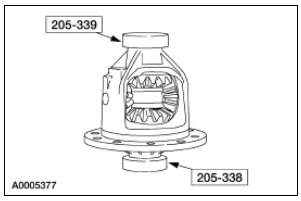
28. Install the drive pinion and the new drive pinion collapsible spacer into the rear axle housing.



29. ⚠ **CAUTION: Take extreme care not to damage aluminum rear axle housing while carrying out these procedures.**

    ⚠ **CAUTION: Master bearings are marked LH and RH and must be installed as shown.**

    Remove the differential bearings and install the special tools on the differential case.

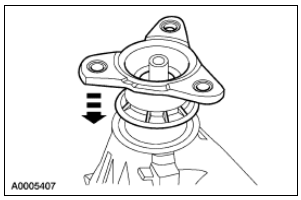


30. **NOTE:** Lubricate the rear axle pinion flange splines. Use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.

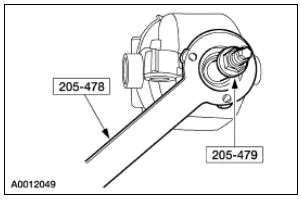
    Install the rear axle pinion flange.

    - **NOTE:** Disregard the scribe marks if a new rear axle pinion flange is being installed.

      Align the rear axle pinion flange with the drive pinion shaft.



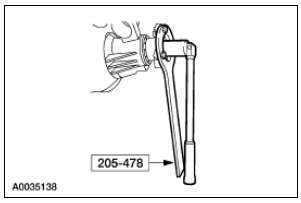
31. With the drive pinion in place in the rear axle housing, install the rear axle pinion flange using the special tools.

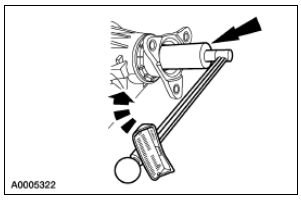


32. ⚠ **CAUTION: Do not under any circumstance loosen the pinion nut to reduce preload. If it is necessary to reduce preload, install a new collapsible spacer (4662) and new pinion nut.**

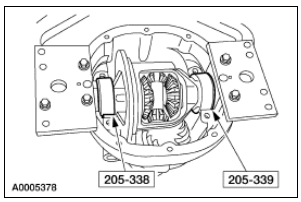
    Use the special tool to hold the pinion flange while tightening the new pinion nut.

    - Rotate the pinion occasionally to make sure the differential pinion bearings (4630) (4621) seat correctly. Take frequent differential pinion bearing torque preload readings by rotating the pinion with a Nm (inch/pound) torque wrench.
    - Refer to the torque specification for pinion bearings in the Specifications portion of this section.

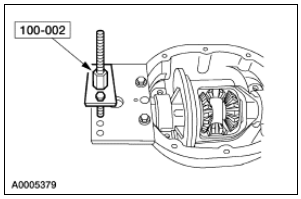




33. Place the differential case and the special tools into the rear axle housing.



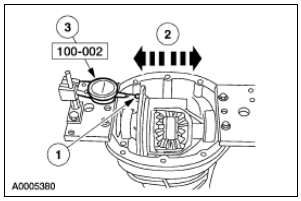
34. Position the special tool on the outside mounting hole.



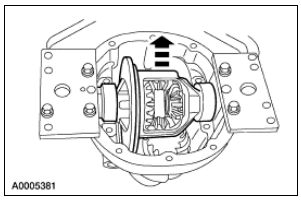
35. **NOTE:** Repeat this step until a consistent reading is obtained.

    Measure the total end play.

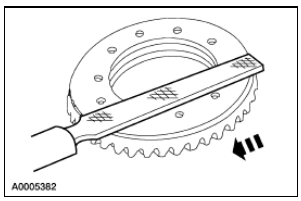
    1. Attach the special tool with the indicator tip positioned on the machined surface of the differential case flange.
    2. Move the differential case to the left and the right (as far as possible).
    3. Record the reading on the differential bearing shim selection procedure line A.



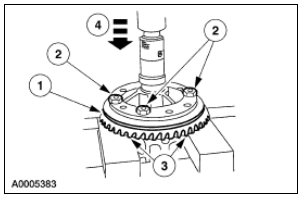
36. Remove the special tool and the differential case from the rear axle housing.



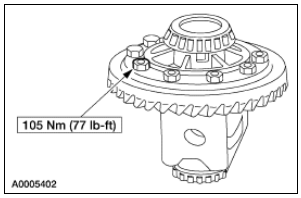
37. Draw-file the differential ring gear mounting surface to remove any nicks or burrs.



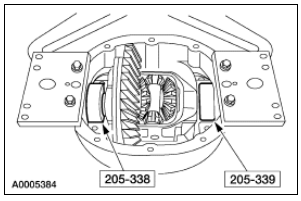
38. Install the ring gear.
    1. Place the ring gear onto the differential case.
    2. Hand start three bolts to align the holes in the ring gear and the differential case.
    3. Place the differential case and ring gear onto the press bed blocks with the ring gear teeth facing down.
    4. Press the ring gear into place.



39. Install the remaining ring gear bolts and tighten to specification.



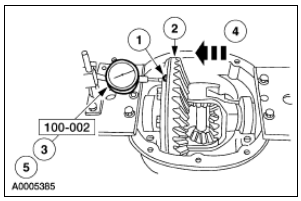
40. Place the differential case, special tools and the ring gear into the rear axle housing.



41. **NOTE:** The ring gear bolt heads inside the rear axle housing may interfere. If so, remove three to five bolts to provide clearance.

    Measure the end play.

    1. Attach the special tool with the indicator tip positioned on the machined surface of the differential case flange.
    2. Rock the ring gear to allow full mesh with the pinion gear.
    3. With the gears in full mesh, set the special tool to zero.
    4. Move the differential case as far as possible to the left and note the reading.
    5. Record the reading on the differential bearing shim selection procedure line B.

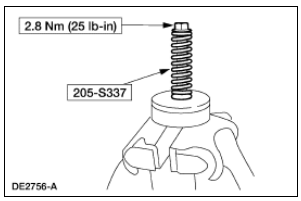


42. Remove the special tool and the differential case from the rear axle housing.

43. **NOTE:** The stand height of both differential bearing assemblies must be measured prior to installation.

    Install the special tool.

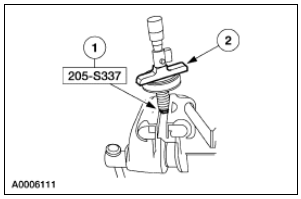
    1. Place the bearing preload gauge base in a soft-jawed vise with the bearing mounting surface above the vise jaws.
    2. Position the differential bearing assembly on the bearing preload tool base.
    3. Attach the bolt, spring, washers and spacer.
    4. Tighten the bolt to specification shown.



44. **NOTE:** Mark the differential bearing assemblies left and right before measuring.

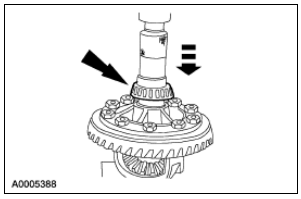
    Measure the differential bearing stand height.

    1. Invert the special tool and clamp the bolt head in a vise.
    2. Position a depth micrometer flat on the differential bearing assembly.

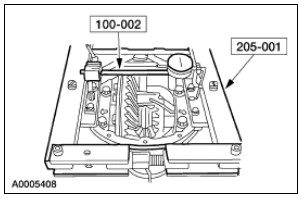


45. Measure the stand height of both differential bearing assemblies and record on the differential bearing shim selection procedure line D.

46. Press the left and right differential bearing on the differential case.



47. Install the special tools.

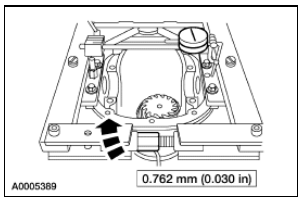


48. ⚠ **CAUTION: Overspreading can damage the rear axle housing.**

    NOTE: Tighten and loosen the housing spreader adapter screw to normalize the Housing Spreader Adapters prior to the final Dial Indicator reading.

    Adjust the Dial Indicator Gauge to zero and tighten the Differential Carrier Spreader screw to spread the rear axle housing to specification.

    - Remove the Dial Indicator Gauge.

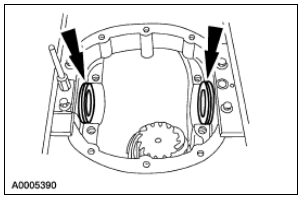


49. **NOTE:** Apply a light coating of Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B to the differential bearing shim to help hold in place.

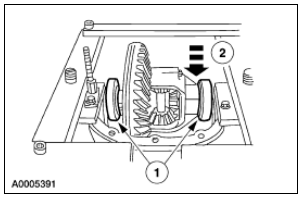
    NOTE: Select the correct size differential bearing shims by using the differential bearing shim selection chart.

    Install the differential bearing shims.

    - Place the differential bearing shims in the rear axle housing.

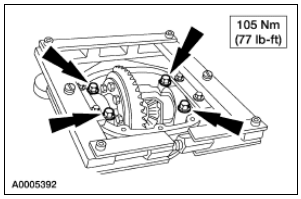


50. Install the differential case.
    1. Position the differential bearing cups on the differential bearings.
    2. Lower the differential case in place between the differential bearing shims.

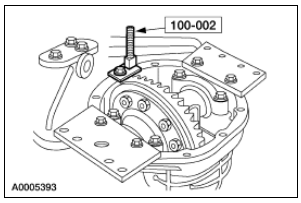


51. **NOTE:** Tighten the bearing cap bolts prior to releasing the housing spreader.

    Install the bearing caps in their original positions and tighten the bolts to specification.



52. Remove the Differential Carrier Spreader and move the Dial Indicator Gauge to the 12 o'clock position.

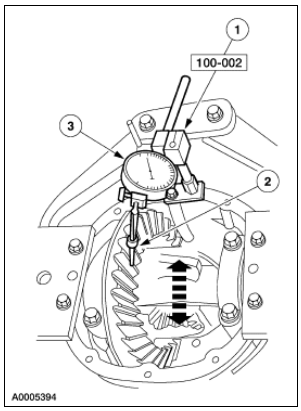


53. **NOTE:** Measure the ring gear backlash at four places to obtain a consistent reading.

    Measure the backlash.

    1. Attach the special tool.
    2. Position the indicator needle centrally on a drive tooth.
    3. Zero the indicator.

    - Turn the ring gear without turning the pinion gear. Record the indicator reading.



54. If the backlash is not to specification, correct by increasing the thickness of one differential bearing shim and decreasing the thickness of the other differential bearing shim by the same amount. Refer to the following tables.

    Differential Bearing Shim Selection Chart

8.0-inch Aluminum Axle	Example	Actual

Line A End play without ring gear	0.498	
Line B End play with ring gear (ring gear side)	-0.245	
Line C Subtract Line B from Line A, also record on Line C, below	0.253	

8.0-inch Aluminum Axle	Left Differential Bearing Height		Right Differential Bearing Height	
	Example	Actual	Example	Actual
Master bearing height	0.8695	0.8695	0.8695	0.8695
Line D Actual bearing height	-0.8478		-0.8491	
Line E Difference	0.0217		0.0204	

8.0-inch Aluminum Axle	Left Side		8.0-inch Aluminum Axle	Right Side	
	Example	Actual		Example	Actual
Line B End play Line E Bearing height	0.2450 +0.0217	+	Line C End play Line E Bearing height	0.2530 +0.0204	+
TOTAL Lines B and E Backlash (subtract)	0.2667 -0.0060	-0.006	TOTAL Lines C and E Backlash/preload (add)	0.2734 +0.020	+0.020
Initial thickness [a]	0.2607		Initial thickness	0.2934	
Final shim thickness left	0.261		Final shim thickness right	0.293	

[a] Round off initial thickness to the nearest shim thickness as in example for final shim thickness.

Backlash Change Required		Thickness Change Required	
mm	Inch	mm	Inch
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.355	0.014	0.457	0.018
0.381	0.015	0.508	0.020

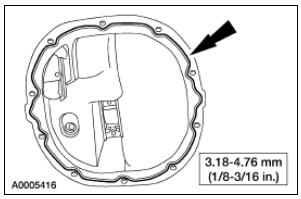
Differential Shim Size Chart 4067

Numbers of Stripes and Color Code	Dimension A	
	mm	Inch
2 C-COAL	7.7978-7.8105	0.3070-0.3075
1 C-COAL	7.7470-7.7597	0.3050-0.3055
5 BLU	7.6962-7.7089	0.3030-0.3035
4 BLU	7.6454-7.6581	0.3010-0.3015
3 BLU	7.5946-7.6073	0.2990-0.2995
2 BLU	7.5458-7.5565	0.2970-0.2975
5 PINK	7.4422-7.4549	0.2930-0.2935
4 PINK	7.3914-7.4041	0.2910-0.2915
3 PINK	7.3406-7.3533	0.2890-0.2895
2 PINK	7.2898-7.3025	0.2870-0.2875
1 PINK	7.2390-7.2517	0.2850-0.2855
5 GRN	7.1882-7.2009	0.2830-0.2835
4 GRN	7.1374-7.1501	0.2810-0.2815
3 GRN	7.0866-7.0993	0.2790-0.2795
2 GRN	7.0358-7.0485	0.2770-0.2775
1 GRN	6.9850-6.9977	0.2750-0.2755
5 WH	6.9342-6.9469	0.2730-0.2735
4 WH	6.8834-6.8961	0.2710-0.2715
3 WH	6.8326-6.8453	0.2690-0.2695
2 WH	6.7818-6.7945	0.2670-0.2675
1 WH	6.7310-6.7437	0.2650-0.2655
5 YEL	6.6802-6.6929	0.2630-0.2635
4 YEL	6.6294-6.6421	0.2610-0.2615
3 YEL	6.5786-6.5913	0.2590-0.2595
2 YEL	6.5278-6.5405	0.2570-0.2575
1 YEL	6.4770-6.4897	0.2550-0.2555
5 ORNG	6.4262-6.4389	0.2530-0.2535
4 ORNG	6.3754-6.3881	0.2510-0.2515
3 ORNG	6.3246-6.3373	0.2490-0.2495
2 ORNG	6.2738-6.2865	0.2470-0.2475
1 ORNG	6.2223-6.2357	0.2450-0.2455
2 RED	6.1722-6.1849	0.2430-0.2435
1 RED	6.1214-6.1341	0.2410-0.2415

55. ⚠ **CAUTION: Make sure the machined surfaces on both the rear axle housing and the differential housing cover are clean and free of oil before installing the new silicone sealant. The inside of the rear axle (4001) must be covered when cleaning the machined surface to prevent contamination.**

If the backlash is within specification, install the differential housing cover.

- Apply a new continuous bead of sealant to the differential housing cover. Use Silicone Rubber D6AZ-19562-AA or equivalent meeting Ford specifications ESB-M4G92-A.

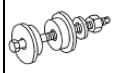
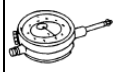
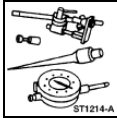
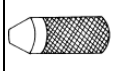
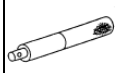


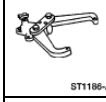
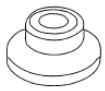
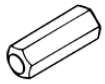
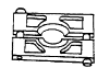
56. Install the rear axle. For additional information, refer to Axle Housing in this section.

57. Refill the rear axle (4001).
    - Fill the rear axle 3-5 mm (1/8-3/16 inch) from the bottom of the filler hole with SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.

Axle Nodular Iron

Special Tool(s)

 ST2026-A	2-Jaw Puller 205-D072 (D97L-4221-A) or Equivalent
 ST1678-A	Installer, Drive Pinion Bearing Cup 205-054 (T71P-4616-A)
 ST1183-A	Dial Indicator Gauge 100-D005 (D78P-4201-G) or Equivalent
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or Equivalent
 ST1375-A	Installer, Differential Side Bearing Replacer 205-010 (T57L-4221-A2)
 ST2458-B	Holding Tool, Drive Pinion Flange 205-478
 ST2452-A	Remover, Output Flange 307-408
 ST1743-A	Depth Gauge/Aligner, Depth Pinion 205-477
 ST1431-A	Adapter for 205-S127 205-110 (T76P-4020-A10)
 ST1743-A	Depth Gauge, Drive Pinion 205-476
 ST1434-A	Gauge Tube, Drive Pinion 205-336 (T93P-4020-A)
 ST1432-A	Adapter for 205-S127 205-111 (T76P-4020-A11)
 ST1326-A	Adapter for 303-224 (Handle) 205 153 (T80T-4000-W)

 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST1344-A	Spreader, Differential Housing (Plate) 205-335 (T93P-4000-A)
 ST1676-A	Installer, Drive Pinion Inner Bearing Cup 205-480
 ST1367-A	Installer, Drive Pinion Bearing Cone 205-005 (T53T-4621-C)
 ST1734-A	Installer, Drive Pinion Flange 205-479
 ST1744-A	Protector, Drive Pinion Thread 205-460
 ST2320-A	Remover, Drive Pinion Inner Bearing Cup 205-481
 ST2320-A	Remover, Drive Pinion Outer Bearing Cup 205-482
ST1429-A	Adapter for 205-S127 205-109 (T76P-4020-A9)
 ST1254-A	Plate, Bearing/Oil Seal 205-090 (T75L-1165-B)
 ST1485-A	Installer, Differential Shim 205 220 (T85L-4067 AH) 15-098
 ST1725-A	Step Plate 205-D061 (D83T-4205-C2) or Equivalent
 ST1310-A	Remover, Bearing 205-055 (T71P-4621-B)

Disassembly

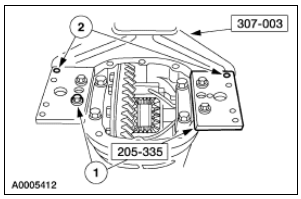
1. Remove the differential housing cover.

2. **NOTE:** The Differential Housing (Plate) Spreader is used here to give the rear axle housing stability. Do not spread the rear axle housing.

   Mount the rear axle housing on the Transmission Holding Fixture.

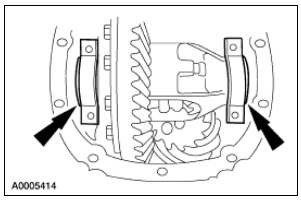
   1. Attach the Differential Housing (Plate) Spreader to the rear axle housing with four cover bolts.

2. Attach the Differential Housing (Plate) Spreader to the Transmission Holding Fixture with two 3/8 inch x 1-1/2 inch bolts.

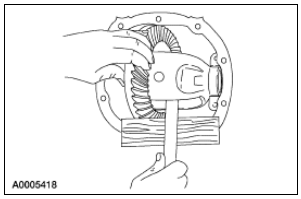


3. **NOTE:** Mark the position of the bearing caps as arrows may not be visible. The bearing caps must be installed in their identical locations and positions.

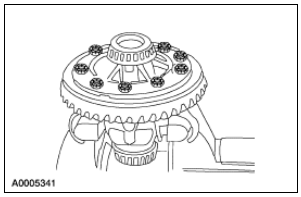
   Remove the differential bearing caps.



4. Remove the differential case (4204).

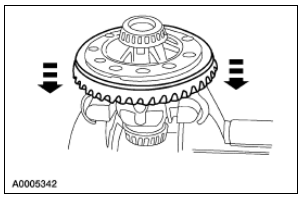


5. Remove the 10 ring gear bolts.

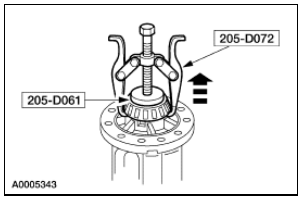


6. ⚠ **CAUTION: Care should be taken not to damage the bolt hole threads.**

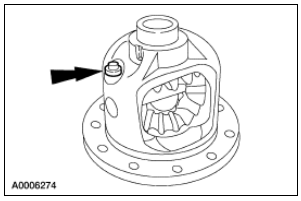
   Insert a punch in the bolt holes and drive the ring gear off.



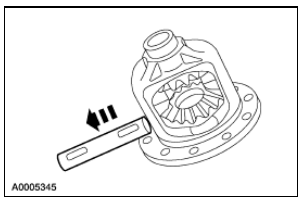
7. Using the special tools, remove the differential bearing (4221).
   - Repeat for the other side.



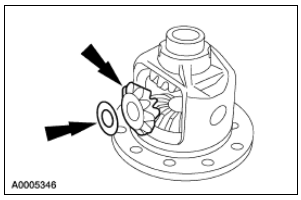
8. Remove the differential pinion shaft lock bolt.



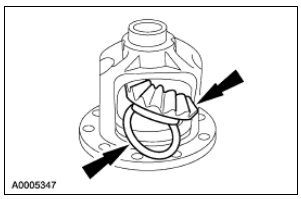
9. Remove the differential pinion shaft.



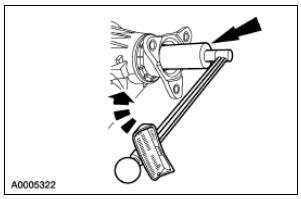
10. Remove the differential gears.



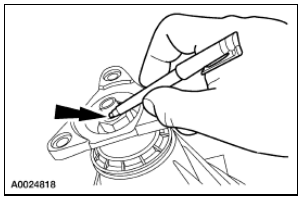
11. Remove the differential side gears.



12. Install a Nm (inch/pound) torque wrench on the pinion nut and record the torque necessary to maintain rotation of the drive pinion gear (4209) through several revolutions.



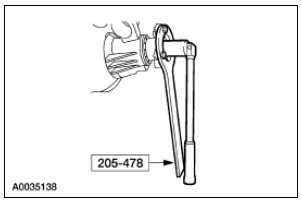
13. Mark the pinion flange in relation to the drive pinion stem to make sure of correct alignment during installation.



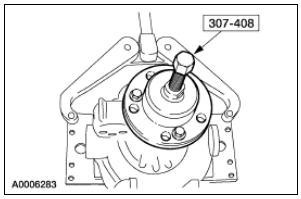
14. ⚠ **CAUTION: After removing the pinion nut, discard it. Use a new nut for installation.**

    Remove the pinion nut.

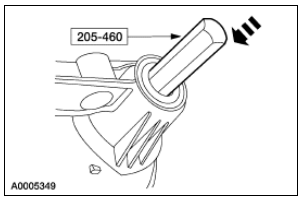
    - Install the special tool.
    - Install a suitable breaker bar and remove the nut.



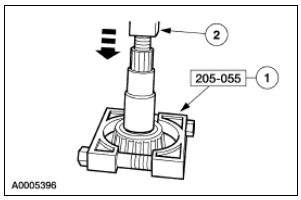
15. Using the special tool, remove the pinion flange.



16. Install the special tool and, with a soft-faced hammer, drive the pinion out of the front bearing cone and remove it through the rear of the housing.
    - Remove the rear axle drive pinion shaft oil slinger (4670), the rear axle drive pinion seal (4676) and the collapsible spacer.

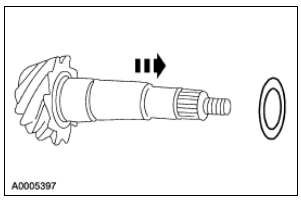


17. Remove the front pinion bearing.
    1. Position the special tool under the pinion bearing.
    2. Using a press, remove the pinion bearing.

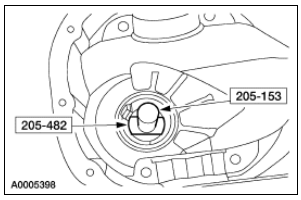


18. **NOTE:** Measure the drive pinion bearing adjustment shim (4663), which is found under the differential pinion bearing, with a micrometer and record the thickness (use this as a reference to compare the shim gauge reading prior to installing the differential pinion bearing).

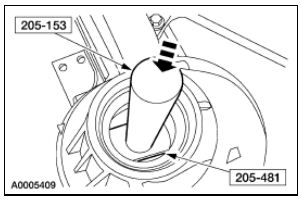
Remove the drive pinion bearing adjustment shim.



19. Remove damaged rear axle pinion bearing cup (4616) from the rear axle housing using the special tools.



20. Remove damaged rear axle pinion bearing cup (4628) from the rear axle housing using the special tools.

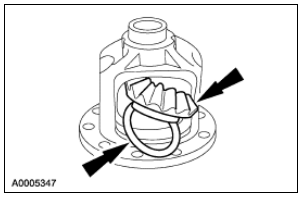


Assembly

All vehicles

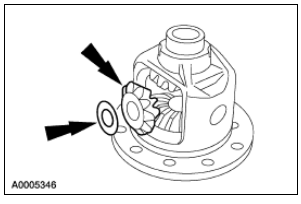
1. ⚠ **CAUTION: Lubricate the differential side gear thrust washers with Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B prior to installation.**

   Install the differential side gears in the differential case.



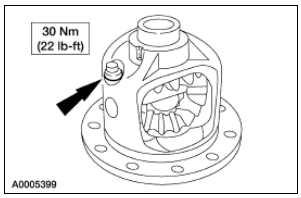
2. ⚠ **CAUTION: Lubricate the differential pinion thrust washers with Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B prior to installation.**

   Install the differential pinion gears with the differential pinion thrust washers in the differential case.

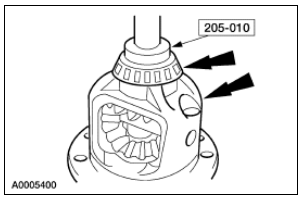


3. **NOTE:** If a new pinion shaft lock bolt is unavailable, coat the threads with Threadlock® and Sealer E0AZ-19554-AA or equivalent meeting Ford specifications WSK-M2G351-A5 prior to installation.

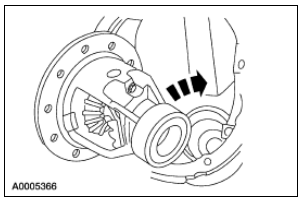
   Install the differential pinion shaft and install a new differential pinion shaft lock bolt.



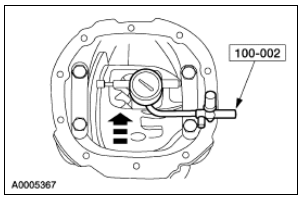
4. Use the special tool to install the differential bearing on the differential case. Repeat for the other side.



5. Install the differential case without the ring gear.
   - Rotate the differential case to correctly seat the differential bearings.

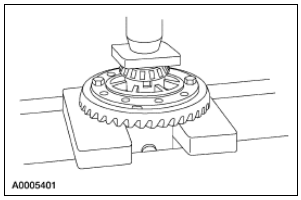


6. Check the differential case flange runout using the special tool.
   - If the runout is within specification, install a new ring gear and pinion. If the runout exceeds specification, the ring gear is true and the concern is due to either a damaged differential case or differential bearings.
   - Inspect the differential bearings. If the differential bearings are not damaged, install a new differential case and the differential bearings.
   - Recheck the runout with the new differential case and differential bearings.

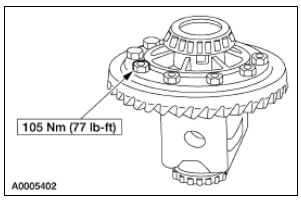


7. Remove the differential case.

8. Press the ring gear on the differential case.
   - Start two of the ring gear bolts through the differential case and into the ring gear to make sure the ring gear bolt holes align with the differential case bolt holes correctly.

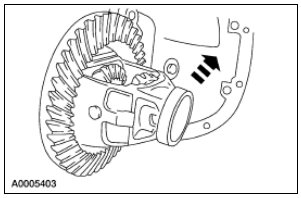


9. Install the ring gear bolts.
    - Apply Stud and Bearing Mount E0AZ-19554-BA or equivalent meeting Ford specification WSK-M2G349-A1 to the ring gear bolts.

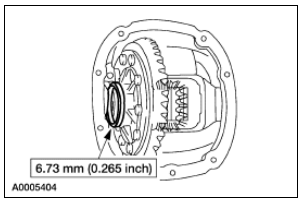


10. **NOTE:** If the ring gear runout check (carried out before disassembly) exceeds specification, the cause may be a warped ring gear, a damaged differential case or loss of differential bearing preload.

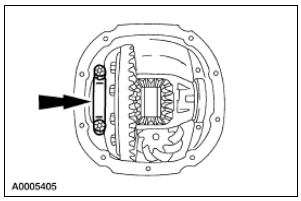
    With the pinion removed, place the differential case/gear subassembly with the differential bearing and the rear axle pinion bearing cups in the rear axle housing.



11. Install a differential bearing shim of the thickness shown on the LH side of the differential case.

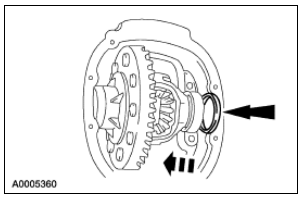


12. Install the LH bearing cap finger-tight.

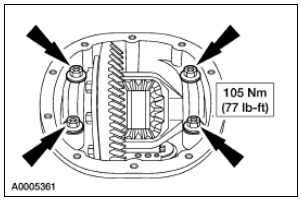


13. **NOTE:** Apply pressure toward the left side to fully seat the differential bearing cup (4222).

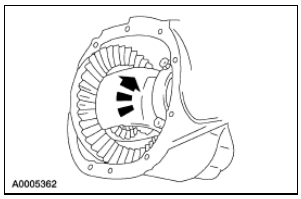
    Install progressively larger differential bearing shims on the RH side until the largest differential bearing shim selected can be assembled with a slight drag feel.



14. Install the RH bearing cap.
    - Tighten both bearing caps to specification.



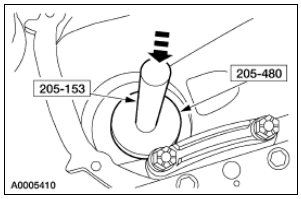
15. Rotate the differential assembly to make sure it rotates freely.



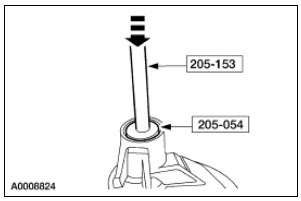
16. Remove the differential case.

Pinion bearing cup installation with special tool 205-153, 205-480, and 205-054

17. Install a new inner rear axle pinion bearing cup in the rear axle housing.



18. Install a new outer rear axle pinion bearing cup in the rear axle housing.

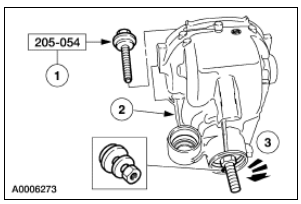


Pinion bearing cup installation with special tool 205-054

19. **NOTE:** Coat the new rear axle pinion bearing cup with SAE 5W-30 Super Premium Motor Oil XO-5W30-QSP or equivalent meeting Ford specification WSS-M2C153-G.

    Install the pinion bearing cup.

    1. Position the rear axle pinion bearing cup on the special tool.
    2. Position the bearing cup replacer in the rear axle housing.
    3. Tighten the special tool to fully seat the rear axle pinion bearing cup in the bore.

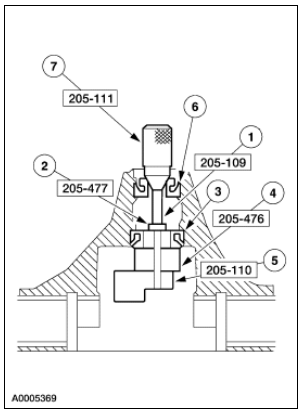


All vehicles

20. **NOTE:** A drive pinion bearing adjustment shim is used between the pinion bearing and the pinion head. The drive pinion bearing adjustment shim compensates for machining variations in the differential pinion and the pinion bearings. The correct drive pinion bearing adjustment shim size will locate the pinion for correct tooth contact with the ring gear. Selecting the correct drive pinion bearing adjustment shim can be done using a pinion depth gauge set.

    NOTE: Apply a light film of SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A on the front differential pinion bearing and the rear differential pinion bearing assemblies.

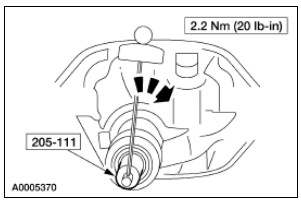
    Install the special tools.



Item	Part Number	Description
1	205-109	Adapter for 205-S127 (T76P-4020-A9)
2	205-477	Gauge aligner, depth pinion
3	4630	Rear (inner) pinion bearing
4	205-476	Gauge disc, drive pinion
5	205-110	Gauge block (1.7 inch thick) (T76P-4020-A10)
6	4621	Front (outer) pinion bearing
7	205-111	Adapter for 205-S127 (T76P-4020-A11)

21. **NOTE:** This step duplicates pinion bearing preload.

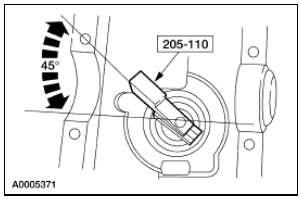
    Thread the Handle onto the Screw and tighten to the specification shown.



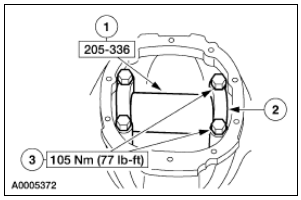
22. **NOTE:** The special tool must be offset to obtain an accurate reading.

    NOTE: Rotate the special tool several half turns to correctly seat the pinion bearings.

    Position the special tool 45 degrees as shown.



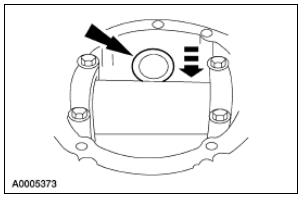
23. Install the special tool.
    1. Position the special tool on the differential bearing seat of the rear axle housing.
    2. Install the differential bearing caps.
    3. Install the differential bearing cap bolts and tighten to specification.



24. **NOTE:** A slight drag should be felt for the correct shim selection.

    NOTE: Use a shim to determine shim thickness.

    Select and check the correct shim size.

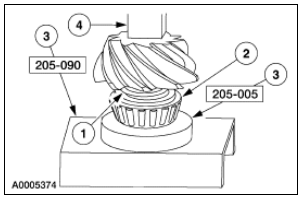


25. Remove the special tool.

26. **NOTE:** The same pinion bearings and drive pinion bearing adjustment shim used in the drive pinion shim selection procedure must be used in the final axle assembly.

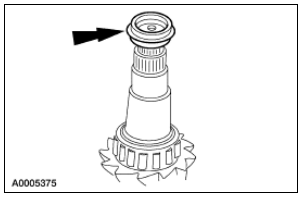
    Install the inner pinion bearing.

    1. Position the drive pinion bearing adjustment shim on the pinion stem.
    2. Position the pinion bearing on the pinion stem.
    3. Position the special tool on the pinion stem.
    4. Using a press, firmly seat the drive pinion bearing adjustment shim and pinion bearing on the pinion stem.

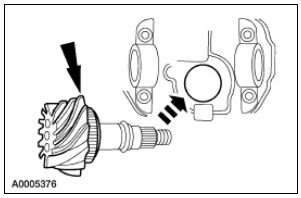


27. **NOTE:** Make sure the splines on the pinion stem are free of burrs. If burrs are evident, remove using a fine crocus cloth, working a rotational motion.

    Place a new drive pinion collapsible spacer on the pinion stem against the pinion stem shoulder.



28. Install the drive pinion and drive pinion collapsible spacer into the rear axle housing.



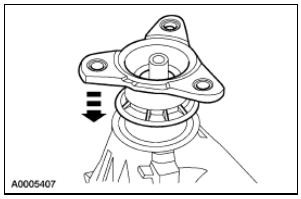
29. Install the outer pinion bearing, the rear axle drive pinion shaft oil slinger and the rear axle drive pinion seal.

30. **NOTE:** Lubricate the rear axle pinion flange splines. Use SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.

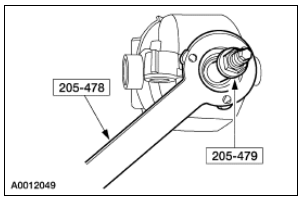
    Install the rear axle pinion flange.

    - **NOTE:** Disregard the scribe marks if a new rear axle pinion flange is being installed.

      Align the rear axle pinion flange with the drive pinion shaft.



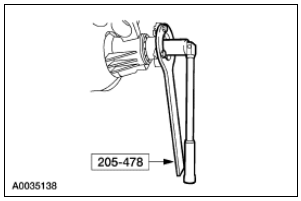
31. With the drive pinion in place in the rear axle housing, install the rear axle pinion flange using the special tools.

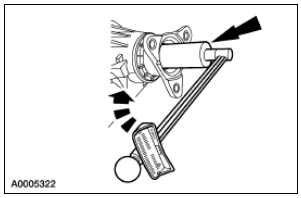


32. ⚠ **CAUTION: Do not under any circumstance loosen the pinion nut to reduce preload. If it is necessary to reduce preload, install a new collapsible spacer (4662) and pinion nut.**

    Use the special tool to hold the pinion flange while tightening the pinion nut.

    - Rotate the pinion occasionally to make sure the differential pinion bearings (4630) (4621) seat correctly. Take frequent differential pinion bearing torque preload readings by rotating the pinion with a Nm (inch/pound) torque wrench.
    - Refer to the torque specification for new pinion bearings in the Specifications portion of this section.



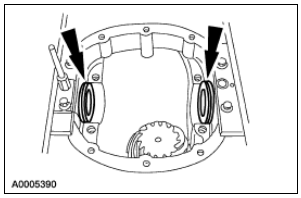


33. **NOTE:** Apply a light coating of Premium Long-Life Grease XG-1-C or equivalent meeting Ford specification ESA-M1C75-B to the differential bearing shim to help hold in place.

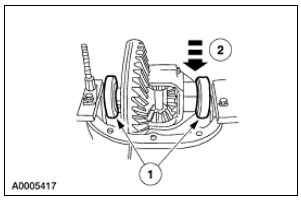
    NOTE: Select the correct size differential bearing shims by using the differential bearing shim selection chart.

    Install the differential bearing shims.

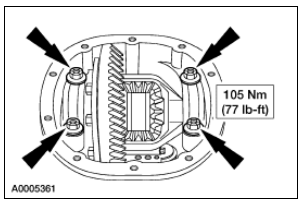
    - Place the differential bearing shims in the rear axle housing.



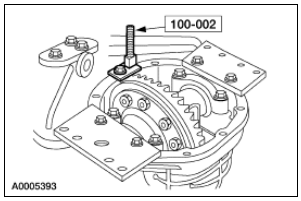
34. Install the differential case.
    1. Position the differential bearing cups on the differential bearings.
    2. Lower the differential case in place between the differential bearing shims.



35. Install the bearing caps in their original positions and tighten the bolts to specification.



36. Move the Dial Indicator Gauge to the 12 o'clock position.



Measuring for backlash

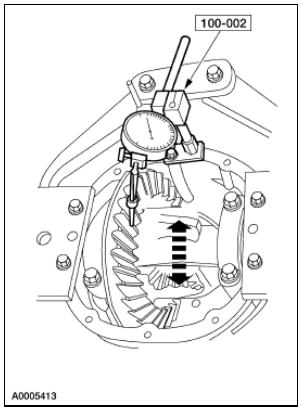
37. **NOTE:** Measure the ring gear backlash at four places to obtain a consistent reading.

    NOTE: Turn the ring gear without turning the pinion gear.

    Measure the backlash.

    - If the backlash is within specification, refer to Backlash within specification in this procedure.
    - If a zero backlash condition occurs, refer to Zero backlash in this procedure.
    - If the backlash is not within specification, refer to Backlash not within specification in this procedure.

Backlash Change Required		Thickness Change Required	
mm	**Inch**	**mm**	**Inch**
0.025	0.001	0.050	0.002
0.050	0.002	0.050	0.002
0.076	0.003	0.101	0.004
0.101	0.004	0.152	0.006
0.127	0.005	0.152	0.006
0.152	0.006	0.203	0.008
0.177	0.007	0.254	0.010
0.203	0.008	0.254	0.010
0.228	0.009	0.304	0.012
0.254	0.010	0.355	0.014
0.279	0.011	0.355	0.014
0.304	0.012	0.406	0.016
0.330	0.013	0.457	0.018
0.355	0.014	0.457	0.018
0.381	0.015	0.508	0.020

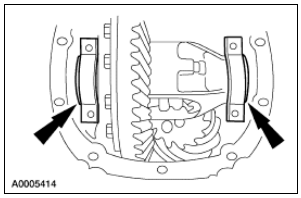


Zero backlash

38. If a zero backlash condition occurs, add 0.51 mm (0.02 in) to the RH side and subtract 0.51 mm (0.02 in) from the LH side to allow backlash indication.
    - Check the backlash. Repeat Measuring ring gear backlash in this procedure.

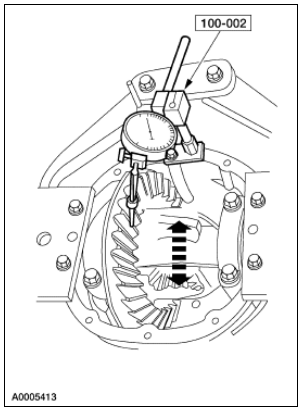
Backlash not within specification

39. To increase or decrease the backlash, remove the bearing caps and install a thicker shim or a thinner shim as shown.
    - If the backlash is not within specification, correct by increasing the thickness of one differential bearing shim and decreasing the thickness of the other differential bearing shim by the same amount.



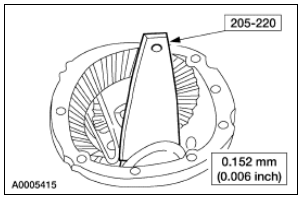
40. Rotate the differential several times to make sure the differential bearings are correctly seated.
    - Do not turn the pinion flange in order to rotate the differential.

41. Use the special tool to recheck the backlash
    - If the backlash is within specification, refer to Backlash within specification in this procedure. If the backlash is not within specification, repeat Measuring ring gear backlash in this procedure.

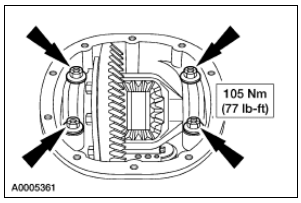


Backlash within specification

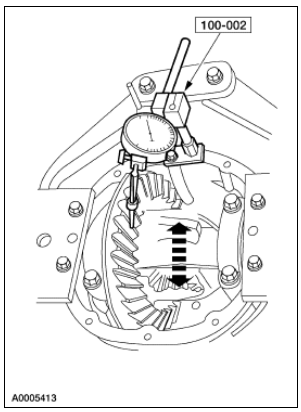
42. Remove the bearing caps and bolts.
    - To establish differential bearing preload, use the special tool to increase both left and right shim sizes by the specification shown.
    - Use the special tool to make sure that the differential bearing shims are fully seated and the assembly turns freely.



43. Install the bearing caps and bolts and tighten them to specification.



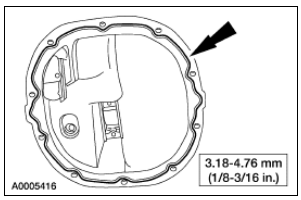
44. Use the special tool to recheck the backlash.
    - For further adjustments, refer to Section 205-00 .



45. ⚠ **CAUTION: Make sure the machined surfaces on both the rear axle housing and the differential housing cover are clean and free of oil before installing the new silicone sealant. The inside of the rear axle (4001) must be covered when cleaning the machined surface to prevent contamination.**

    Install the differential housing cover.

    - Apply a new continuous bead of sealant to the differential housing cover. Use Silicone Rubber D6AZ-19562-AA or equivalent meeting Ford specifications ESB-M4G92-A.



46. Install the rear axle. For additional information, refer to Axle Housing in this section.

47. Refill the rear axle (4001).
    - Fill the rear axle 3-5 mm (1/8-3/16 inch) from the bottom of the filler hole with SAE 75W-140 High Performance Rear Axle Lubricant F1TZ-19580-B or equivalent meeting Ford specification WSL-M2C192-A.

Torque Specifications

Description	Nm	lb-ft
Rear axle wheel hub retainer	300	221

Rear Drive Halfshafts

⚠ CAUTION: An inspection of the outer and inner boots is necessary so that if damage or grease leakage is evident, installation of a new halfshaft can take place immediately. Continued operation with damage or grease leakage will result in CV joint wear and noise due to contamination and loss of the CV joint grease.

⚠ CAUTION: Vehicles with V8 engines use a larger diameter halfshaft than vehicles with V6 engines. Do not install the smaller diameter halfshafts designed for vehicles with V6 engines on vehicles with V8 engines or vise-versa.

- The RH and LH halfshafts are different lengths, with the RH halfshaft being the longer of the two.
- Inboard and outboard CV joints connect to a splined shaft. A circlip stopper holds the cross groove inboard race assembly (inboard CV joint) together.
- An axle circlip (4B422) retains the splined inboard CV joint to the differential side gear. Install a new axle circlip every time you remove the halfshaft from the vehicle.
- A rear axle wheel hub retainer secures the side shaft assembly (interconnecting shaft and outboard CV joint) to the rear hub. Install a new rear axle wheel hub retainer every time you remove the halfshaft from the vehicle.

Halfshaft Handling

⚠ CAUTION: Never pick up or hold the halfshaft only by the inboard or outboard CV joint.

Handle all halfshaft components carefully during removal and installation procedures.

- The halfshaft assemblies are not repairable. Install a new assembly if worn/damaged.
- To separate the halfshaft from the rear hub, press the outboard CV joint from the rear hub.
- To separate the halfshaft from the differential, apply a load to the back face of the inboard CV joint assembly to overcome the axle circlip.
- Do not over-angle the CV joints.
- Damage will occur to an assembled inboard CV joint if it is over-plunged outward from the joint housing.
- Never use a hammer to remove or install the halfshafts.
- Never use the halfshaft assembly as a lever to position other components. Always support the free end of the halfshaft.
- Do not allow the boots to contact sharp edges or hot exhaust components.
- Handle the halfshaft only by the interconnecting shaft to avoid pull-apart and potential damage to the CV joints.
- Do not drop assembled halfshafts. The impact will cut the boots from the inside without evidence of external damage.

Wheel and Tire Balancing, Rear

⚠ WARNING: Do not balance the rear wheels and tires while mounted on the vehicle. Possible tire disintegration, differential or halfshaft failure can result, causing personal injury or extensive component damage. Use an off-vehicle wheel and tire balancer only.

Hoisting

⚠ CAUTION: Use a frame-contact hoist only. Vehicle or component damage can result if other types of hoists are used.

Never raise the vehicle using the halfshafts as lift points.

Undercoating and Rustproofing

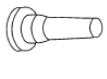
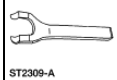
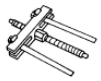
During undercoating and rustproofing procedures, protect the boots from the coating materials. Foreign materials on the rubber boots will cause extreme advanced wear.

Rear Drive Halfshafts

Refer to Section 205-00 .

Halfshaft

Special Tool(s)

 ST1712-A	Differential Plug 205-294 (T89P-4850-B)
 ST2258-A	Differential Seal Protector 205-461
 ST2309-A	Halfshaft Removal Tool 205-475
 ST1516-A	Hub Remover/Replacer 204-069 (T81P-1104-C)
 ST1517-A	Metric Hub Remover Adapter 205-237 (T86P-1104-A1)
 ST1518-A	Metric Hub Remover Adapters 204-085 (T83P-1104-BH)

Removal

1. ⚠ **CAUTION: Do not begin this procedure unless:**

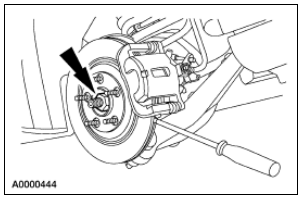
   - a new rear axle wheel hub retainer is available.
   - a new axle circlip (4B422) is available.
   - you have read Halfshaft Handling in this section.

   NOTE: This procedure applies to both the LH and RH halfshafts.

   Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Remove the rear wheel and tire assembly. For additional information, refer to Section 204-04 .

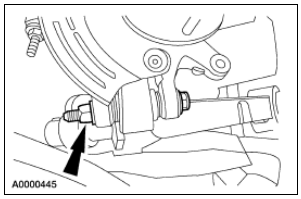
3. Remove and discard the rear axle wheel hub retainer.


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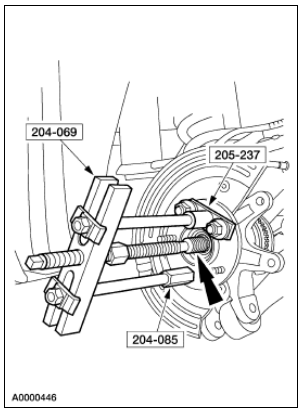
4. Remove the rear brake anti-lock sensor. For additional information, refer to Section 206-09A .

5. Remove the brake disc. For additional information, refer to Section 206-04 .

6. Remove the nut and bolt.

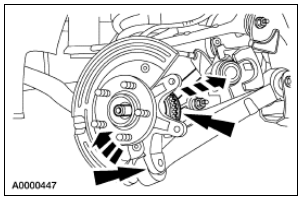


7. Using the special tools, press the outboard CV joint until it is loose in the hub.

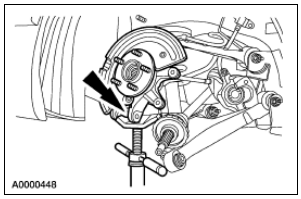


8. ⚠ **CAUTION: Do not over-angulate the outboard CV joint or damage the boot.**

   While raising the knuckle, remove the CV joint from the hub.

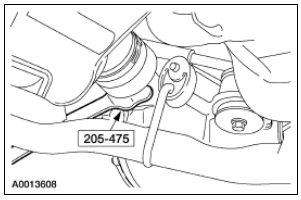


9. Position the knuckle to gain clear access for the halfshaft removal.



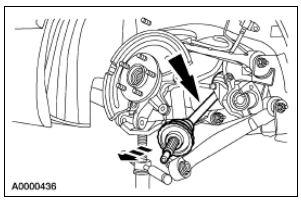
10. ⚠ **CAUTION: The crown of the tool forks must face away from the axle housing. Position the special tool correctly between the CV joint and the axle housing so as not to damage the differential seal.**

    Using the special tool, exert enough pressure to overcome the axle circlip (4B422) and separate the CV joint from the differential side gear.

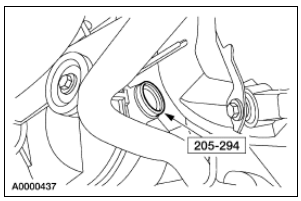


11. ⚠ **CAUTION: Do not damage the differential seal.**

    Carefully remove the halfshaft with both hands.



12. Install the special tool.

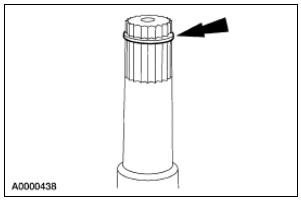


Installation

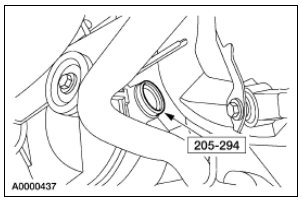
1. ⚠ **CAUTION: Vehicles with V8 engines use a larger diameter halfshaft than vehicles with V6 engines. Do not install the smaller diameter halfshafts designed for vehicles with V6 engines on vehicles with V8 engines or vise-versa.**

   NOTE: This procedure applies to both the LH and RH halfshafts.

   Install a new axle circlip.

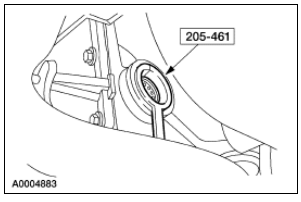


2. Remove the special tool.

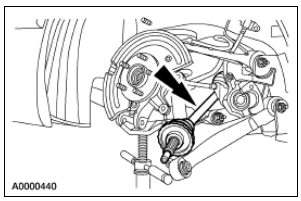


3. ⚠ **CAUTION: Differential seal damage will occur if installing the halfshaft without the special tool installed.**

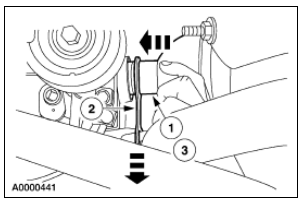
   Install the special tool.



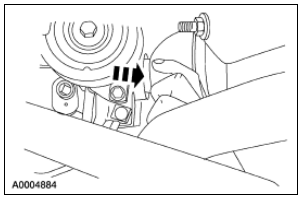
4. Position the halfshaft for installation.



5. Seat the CV joint in the differential side gear.
    1. Slide the CV joint into the axle housing until the shaft splines are past the differential seal.
    2. Remove the special tool.
    3. Align the CV joint and side gear splines, and slide the joint into the gear until it seats.
        - ♦ When seated, the axle circlip will lock the CV joint in the differential side gear.

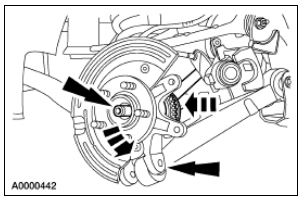


6. Check the axle circlip engagement by attempting to pull the inboard CV joint out of the differential side gear.
    - If the circlip is not seated, push the CV joint inward until the circlip is fully engaged in the differential side gear.



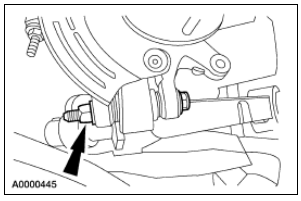
7. ⚠ **CAUTION: Do not over-angulate the outboard CV joint or damage the boot.**

    While raising the knuckle, install the CV joint into the hub, then position the knuckle onto the lower control arm.

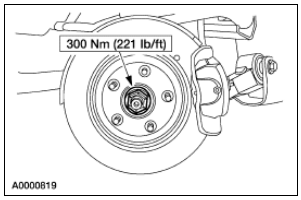


8. ⚠ **CAUTION: Position the suspension at curb ride height before tightening the bolt and nut.**

    Install the bolt and nut. Refer to Section 204-02 for tightening specifications.



9. Install the brakes. For additional information, refer to Section 206-04 .
10. Install the rear brake anti-lock sensor. For additional information, refer to Section 206-09A .
11. Install the rear axle wheel hub retainer.



12. Install the rear wheel and tire assembly. For additional information, refer to Section 204-04 .
13. Lower the vehicle.

Halfshaft Joint

Disassembly

1. The halfshaft assemblies are not repairable. Install a new assembly if worn/damaged.

General Specifications

Item	Specification
Brake pads lining wear limit front (above backing plate or rivets)	2 mm (0.08 in)
Brake pads lining wear limit rear (above brake shoe or rivets)	1 mm (0.04 in)
Lubricant	
High Performance DOT 4 Brake Fluid	FMVSS No. 116
High Performance DOT 3 Brake Fluid PM-1 (Canada CXC-31)	ESA-M6C25-A (United States and Canada only)
High Temperature Nickel Anti-Seize Lubricant XL-2 (Canada CXG-2-B)	ESE-M12A4-A
Brake Disc	
Brake disc minimum thickness	Molded into the brake disc
Brake disc allowable runout on vehicle	0.102 mm (0.004 in)
Brake disc maximum thickness variation	0.01 mm (0.0004 in)

Torque Specifications

Description	Nm	lb-ft
Brake master cylinder tube fitting, front	15-20	11-15
Brake master cylinder tube fitting, rear	15-20	11-15
Caliper bleeder screw, rear	17-24	12-18
Caliper bleeder screw, front	7-13	7.5

Brake System

Brake System, Hydraulic

This vehicle is equipped with a brake pedal-actuated hydraulic dual brake system. The system consists of the following:

- front disc brake calipers (2B120). For additional information, refer to Section 206-03 .
- rear disc brake calipers (2553). For additional information, refer to Section 206-04 .
- brake master cylinder (2140). For additional information, refer to Section 206-06 .
- brake tubes and brake hoses.

The ABS system is a four wheel anti-lock control traction control brake system. For additional information, refer to Section 206-09B .

The dual ABS hydraulic system is diagonally split with the LH front and RH rear making up one circuit and the RH front and LH rear making up the other circuit.

Master Cylinder, Dual

The brake master cylinder contains the following feature:

- a common plastic brake master cylinder reservoir (2K478) and low fluid level indicator combined in one assembly.

Booster, Power Brake

The power brake booster (2005) is a vacuum-operated, dual diaphragm type and is equipped with a separately serviceable power brake booster check valve (2365). For additional information, refer to Section 206-07 .

Brakes, Front Disc

The front disc brakes consist of the following features:

- a full-cast vented front brake disc (1125).
- hydraulically-activated pin slider-type front disc brake caliper assemblies.

Brakes, Rear Disc

The rear disc brakes consist of the following features:

- a full-cast vented rear brake disc (2C026).
- hydraulically-activated rear disc brake caliper assemblies with integral mechanically (cable) operated parking brake mechanisms.

Brake System, Parking

The parking brake system consists of the following features:

- the system is cable-actuated and controlled by a hand-operated parking brake control (2780).
- the parking brake control pulls a cable which actuates the rear disc brake calipers.
- the parking brake is self-adjusting.

For additional information, refer to Section 206-05 .

Brake Fluid

⚠ WARNING: Use of any other than approved DOT 3 or DOT 4 brake fluid will cause permanent damage to brake components and will render the brakes inoperative.

⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

⚠ CAUTION: Brake fluid is harmful to painted or plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

Use clean, fresh Ford High Performance DOT 3 Motor Vehicle Brake Fluid PM-1 (Canada CXC-31) or equivalent meeting Ford specification ESA-M6C25-A.

If DOT 3 is not available, use Ford High Performance DOT 4 brake fluid or equivalent meeting FMVSS No. 116.

- Do not reuse brake fluid drained or bled from the system.
- Do not use brake fluid that has been stored in an open container.
- Do not use contaminated brake fluid.

Brake Tubing

⚠ WARNING: Copper tubing must not be used in a hydraulic system. When bending brake tubing to fit underbody, be careful not to kink or crack the tube.

If a section of the brake tubing becomes damaged, install a new section of tubing the same type, size, shape and length.

Brake Hose

Install a new flexible brake hose if it shows signs of softening, cracking or other damage.

Brake System

Refer to Wiring Diagrams Cell 60 , Instrument Cluster for schematic and connector information.

Inspection and Verification

Preliminary Checks

NOTE: Always check the fluid level in the brake master cylinder reservoir (2K478) before carrying out the test procedures. If the fluid level is not at the correct level, fill the reservoir using the specified DOT 3 or DOT 4 brake fluid.

NOTE: Prior to carrying out any diagnosis, make certain that the brake warning indicator is functional. Refer to Section 413-01 .

The first indication that something may be wrong in the brake system is a change in the feeling through the brake pedal (2455). The brake warning indicator in the instrument cluster and the brake fluid level in the brake master cylinder reservoir are also indicators of system concerns.

If a wheel (1007) is locked and the vehicle must be moved, open a bleeder screw at the locked wheel to let out enough fluid to relieve the pressure. Close the bleeder screw. This bleeding operation may release the brakes but will not correct the cause of trouble. If this does not relieve the locked wheel condition, repair the locked components before proceeding.

Brake Booster

Inspect all hoses and connections. All unused vacuum connectors should be capped. Hoses and their connections should be correctly secured and in good condition with no holes, soft or collapsed areas.

Road Test

Carry out a road test to compare actual vehicle braking performance with the performance standards expected by the driver. The ability of the test driver to make valid comparisons and detect performance deficiencies will depend on experience.

The driver should have a thorough knowledge of brake system operation and accepted general performance guidelines in order to make good comparisons and detect performance problems.

Select a road that is reasonably smooth and level. Gravel or bumpy roads are not suitable because the surface does not allow the tires to grip the road equally. Avoid crowned roads.

A key factor in evaluating brake concerns is the deceleration rate. This varies from vehicle to vehicle and with changes in operating conditions. It is evident how well the brakes are working after just a few applications.

Avoid locking the brakes. Locked brakes are not an indicator of braking efficiency.

Visual Inspection Chart

Mechanical	Electrical
• Brake master cylinder • Brake caliper piston • Brake disc • Wheel hubs • Brake pads • Power brake booster • Brake pedal linkage • Booster vacuum hose • Tires • Foreign material	• Parking brake switch • Damaged or corroded wiring harness • Brake master cylinder fluid level switch

For low or spongy brake pedal concerns:

- Check and, if necessary, refill the brake master cylinder reservoir.
- Bleed the brake system and retest the brake pedal feel.

For slow or incomplete brake pedal return concern:

- Inspect for binding, damage, incorrect installation or interference at the brake pedal.
- Check the power brake booster for binding, damage and incorrect installation.

Vibration When Brakes Are Applied

For vibration concerns when brakes are applied, carry out the following procedure.

Visually inspect:

- The suspension condition and tire pressure.
- Suspension bushings and ball joints.

Correct as necessary.

1. Verify and isolate the concern. Brake roughness can be felt in:

- the steering wheel.
- the seat.
- the brake pedal.

2. After verifying the concern, check for related concerns in the:

- On-Line Automotive Service Information System (OASIS).
- Technical Service Bulletins.

3. Check wheel bearing end-play and correct as necessary.

4. **NOTE:** Begin at the front of the vehicle unless the vibration has been isolated to the rear.

   Remove the tire and wheel.

5. Remove the brake caliper.

6. Measure and record the brake disc thickness. If the thickness before machining is not greater than 0.6 mm (0.024 in) above the minimum thickness specification molded into the brake disc, install a new brake disc. Do not machine a new brake disc.

7. For vehicles with a two-piece hub and brake disc assembly:

- Match-mark before disassembly.
- Remove the brake disc.
- Using a die grinder with a mild abrasive disc (Scotch Brite® type), remove any rust or corrosion from the hub and brake disc mounting surfaces.
- Align match-marks and reinstall the brake disc on the hub.

8. ⚠ **CAUTION: Do not use a bench lathe to machine brake discs.**

   NOTE: The depth of cut must be between 0.10 and 0.20 mm (0.004 and 0.008 in). Lighter cuts will cause heat and wear. Heavier cuts will cause poor brake disc surface finish.

   Using a hub-mount brake lathe, machine the brake discs. Follow the manufacturer's instructions. After machining, make sure the brake disc still meets the thickness specification.

9. Using a dial indicator, verify that the brake disc lateral runout is now within vehicle specification.

10. Remove metal chips.

11. Remove the brake lathe hub adapter.

12. Remove any remaining metal chips from the machining operation.

13. For vehicles with a two-piece hub and brake disc assembly:

- Remove the brake disc from the hub.
- Remove any remaining metal chips from hub and brake disc mounting surfaces and from the ABS sensor.
- Apply High Temperature Nickel Anti-Seize Lubricant XL-2 (Canada CXG-2-B) or equivalent meeting Ford specification ESE-M12A4 A to the mounting surfaces.
- Using the match-marks, mount the brake disc on the hub.

14. Install the caliper and check brake operation.

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: THE BRAKES PULL OR DRIFT

PINPOINT TEST B: THE RED BRAKE WARNING INDICATOR IS ALWAYS ON - PARKING BRAKE/LOW BRAKE FLUID LEVEL SENSOR

PINPOINT TEST C: BRAKES LOCK UP DURING LIGHT BRAKE PEDAL FORCE

PINPOINT TEST D: EXCESSIVE/ERRATIC BRAKE PEDAL TRAVEL

Component Tests

Brake Booster

1. Check the hydraulic brake system for leaks or insufficient fluid.

2. With the transmission (7003) in NEUTRAL, stop the engine (6007) and apply the parking brake control (2780). Apply the brake pedal several times to exhaust all vacuum in the system.

3. Apply the brake pedal and hold it in the applied position. Start the engine. If the vacuum system is operating, the brake pedal will tend to move downward under constant foot pressure. If no motion is felt, the power brake booster system is not functioning. Continue the test with the following steps.

4. Remove the vacuum booster hose (2A047) from the check valve connection. Manifold vacuum must be available at the check valve end of the vacuum booster hose with the engine at idle speed and the transmission in NEUTRAL. If the manifold vacuum is available to the power brake booster, connect the vacuum booster hose to the power brake booster check valve (2365) and repeat Steps 2 and 3 above.

5. Check and if no downward movement of the brake pedal is felt, install a new power brake booster.

6. Operate the engine a minimum of 10 seconds at fast idle. Stop the engine, and let the vehicle stand for 10 minutes. Then apply the brake pedal with approximately 89 N (20 lbs) of force. The brake pedal feel should be the same as that noted with the engine operating. If the brake pedal feels hard (no power assist), install a new check valve and retest. If the brake pedal feels spongy, bleed the hydraulic system to remove air. Refer to Brake System Bleeding in this section.

Check Valve

The function of the power brake booster check valve is to allow manifold vacuum to enter the power brake booster and prevent the escape of vacuum in the event manifold vacuum is lost during sustained full throttle operation.

To test the function of the power brake booster check valve:

- Start and run the engine for at least 10 seconds.
- Operate the brake pedal to check for power assist.
- Disconnect the vacuum booster hose from the power brake booster. Do not remove the power brake booster check valve from the power brake booster.
- There should be enough vacuum retained in the power brake booster for at least one more power-assisted brake operation.

Brake Master Cylinder

Normal Conditions

The following conditions are considered normal.

Condition 1: During normal operation of the brake master cylinder, the fluid level in the brake master cylinder reservoir will rise during brake application and fall during release. The net fluid level (after brake application and release) will remain unchanged.

Condition 2: A trace of brake fluid will exist on the booster shell below the master cylinder mounting flange. This results from the normal lubricating action of the master cylinder bore and seal.

Condition 3: Fluid level will decrease with pad wear.

Abnormal Conditions

Changes in brake pedal feel or travel are indicators that something could be wrong in the brake system. GO to Symptom Chart for abnormal condition diagnosis.

Bypass Condition Test

1. Disconnect the brake lines at the brake master cylinder.
2. Plug the outlet ports of the brake master cylinder.
3. Apply the brakes. If brake pedal height cannot be maintained, the brake master cylinder has an internal leak and a new master cylinder must be installed.

Compensator Port Check

The purpose of the compensator ports in the brake master cylinder is to supply any additional brake fluid required by the system due to brake pad wear and to allow brake fluid returning from the brake lines to the brake master cylinder to enter the brake master cylinder reservoir.

The returning brake fluid will cause a slight turbulence in the brake master cylinder reservoir. Turbulence seen in the brake master cylinder reservoir upon release of the brake pedal is normal and shows that the compensating ports are not plugged.

Brake System Bleeding

Manual

⚠ WARNING: Use of any other than approved DOT 3 or DOT 4 brake fluid will cause permanent damage to brake components and will render the brakes inoperative.

⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

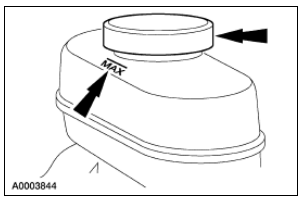
⚠ CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

⚠ CAUTION: Do not allow the brake master cylinder reservoir to run dry during the bleeding operation. Keep the brake master cylinder reservoir filled with the specified brake fluid. Never reuse the brake fluid that has been drained from the hydraulic system.

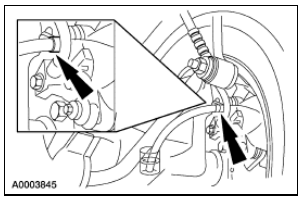
NOTE: When any part of the hydraulic system has been disconnected for repair or installation of new components, air can get into the system and cause spongy brake pedal action. This requires bleeding of the hydraulic system after it has been correctly connected. The hydraulic system can be bled manually or with pressure bleeding equipment.

1. Connect the scan tool cable adapter into the vehicle data link connector (DLC) under the dash and follow the scan tool instructions.

2. Clean all dirt from and remove the brake master cylinder filler cap and fill the brake master cylinder reservoir with the specified brake fluid.



3. Place a box end wrench on the RH rear bleeder screw. Attach a rubber drain tube to the RH rear bleeder screw and submerge the free end of the tube in a container partially filled with clean brake fluid.

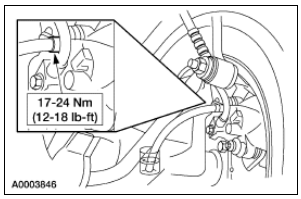


4. Have an assistant hold firm pressure on the brake pedal.

5. Loosen the RH rear bleeder screw until a stream of brake fluid comes out. While the assistant maintains pressure on the brake pedal, tighten the RH rear bleeder screw.

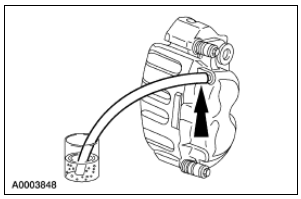
- Repeat until clear, bubble-free fluid comes out.
- Refill the brake master cylinder reservoir as necessary.

6. Tighten the RH rear bleeder screw.



7. Repeat Steps 3, 4, 5 and 6 for the LH rear bleeder screw.

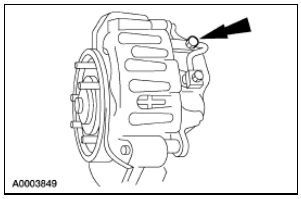
8. Place a box end wrench on the RH front disc brake caliper bleeder screw. Attach a rubber drain tube to the RH front disc brake caliper bleeder screw, and submerge the free end of the tube in a container partially filled with clean brake fluid.



9. Have an assistant hold firm pressure on the brake pedal.

10. Loosen the RH front disc brake caliper bleeder screw until a stream of brake fluid comes out. While the assistant maintains pressure on the brake pedal, tighten the RH front disc brake caliper bleeder screw.
    - Repeat until clear, bubble-free fluid comes out.
    - Refill the brake master cylinder reservoir as necessary.

11. Tighten the RH front disc brake caliper bleeder screw. For additional information, refer to Specifications.



12. Repeat Steps 8, 9, 10 and 11 for the LH front disc brake caliper bleeder screw.

Pressure

⚠ WARNING: Use of any other than approved DOT 3 or DOT 4 brake fluid will cause permanent damage to brake components and will render the brakes inoperative.

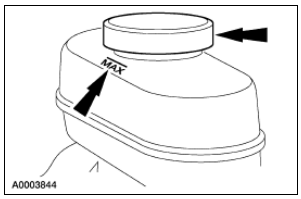
⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

⚠ CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a

painted or plastic surface, immediately wash it with water.

⚠ CAUTION: Do not allow the master cylinder to run dry during the bleeding operation. Keep the master cylinder reservoir filled with the specified brake fluid. Never reuse the brake fluid that has been drained from the hydraulic system.

1. Clean all dirt from and remove the brake master cylinder filler cap and fill the brake master cylinder reservoir with the specified brake fluid.

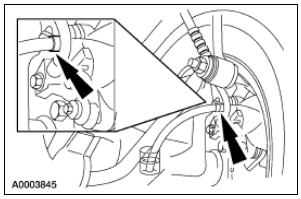


2. **NOTE:** Master cylinder pressure bleeder adapter tools are available from various manufacturers of pressure bleeding equipment. Follow the instructions of the manufacturer when installing the adapter.

   Install the bleeder adapter to the brake master cylinder reservoir, and attach the bleeder tank hose to the fitting on the adapter.

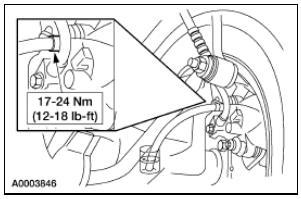
3. **NOTE:** Bleed the longest line first. Make sure the bleeder tank contains enough specified brake fluid to complete the bleeding operation.

   Place a box end wrench on the RH rear bleeder screw. Attach a rubber drain tube to the RH rear bleeder screw, and submerge the free end of the tube in a container partially filled with clean brake fluid.



4. Open the valve on the bleeder tank.

5. Loosen the RH rear bleeder screw. Leave open until clear, bubble-free brake fluid flows, then tighten the RH rear bleeder screw and remove the rubber hose.



6. Continue bleeding the rear of the system, going in order from the LH rear bleeder screw to the RH front disc brake caliper bleeder screw ending with the LH front disc brake caliper bleeder screw.

7. Close the bleeder tank valve. Remove the tank hose from the adapter, and remove the adapter.

Brake System Leak Check

1. **NOTE:** Brake fluid is water soluble and it is possible that all evidence of fluid leakage has been washed off if the vehicle has been operated in the rain or snow.

   Make sure the brake master cylinder reservoir (2K478) is full.

2. Apply the brakes several times and make sure the brake pedal (2455) feel is not spongy. If necessary, bleed the system. For additional information, refer to Brake System Bleeding in this section.

3. Verify that the reservoir level is dropping.

4. If the reservoir level is dropping, inspect the brake components, fittings and lines to locate the source of the leak.

General Specifications

Item	Specification
Brake Disc	
Minimum thickness [a]	28.00 mm (1.12 in)
Pad	
Minimum thickness above metal backing plate or rivets	2 mm (0.079 in)
Fluid	
High Performance DOT 3 Brake Fluid PM-1 (Canada CXC-31)	ESA-M6C25-A
High Performance DOT 4 Brake Fluid	FMVSS No. 116
Lubricant	
Silicone Brake Caliper Grease and Dielectric Compound XG-3	ESE-M1C171-A
High Temperature Nickel Anti-Seize Lubricant XL-2	ESE-M12A4-A
Rust Penetrant and Inhibitor XL-1	ESR-M99C56-A
Cleaners	
Brake Parts Cleaner PM-4	

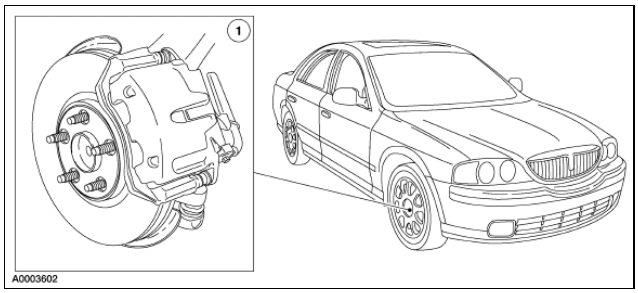
[a] Minimum safe thickness is shown on each brake disc.

Torque Specifications

Description	Nm	lb-ft
Caliper bolts	35	26
Caliper flow bolt	47	35
Anchor plate bolts	103	76

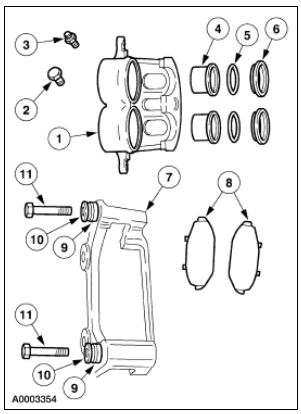
Front Disc Brake

Front Disc Brake



Item	Part Number	Description
1	2B120	Front disc brake caliper assy

Disc Brake Caliper Components



Item	Part Number	Description
1	2B120	Disc brake caliper
2	2L126	Bleeder screw cap
3	2208	Bleeder screw
4	2196	Caliper piston
5	2B115	Piston seal
6	2207	Piston dust boot
7	2B292	Front disc brake caliper anchor plate
8	2001	Brake pads
9	2A492	Guide pin boot
10	2B296	Guide pin
11	2N386	Caliper bolt

The front disc brake caliper (2B120):

- bolts to the front disc brake caliper anchor plate (2B292), which bolts to the front wheel spindle (3105).
- is a disc brake caliper locating pin, dual piston design one piston is 38mm the other piston is 45mm.
- has a fluid inlet at the bottom of the caliper housing.

The front brake discs (1125):

- are of a ventilated full-cast design, with non-directional cooling fins.
- are serviced with the disc brake caliper and front disc brake caliper anchor plate removed.

The front brake disc shield (2K005):

- is riveted to the front wheel spindle.
- protects the front wheel bearings and inboard surface of the front brake disc.

The pads (2001):

- are housed in the front disc brake caliper anchor plate.
- are of a non-asbestos, non-metallic composition.

Brake Fluid

⚠ WARNING: Use of any other than approved DOT 4 or DOT 3 brake fluid will cause permanent damage to brake components and will render the brakes inoperative.

⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

⚠ CAUTION: Brake fluid is harmful to painted or plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

Use clean, fresh Ford High Performance DOT 3 Motor Vehicle Brake Fluid C6AZ-19542-AB or equivalent meeting Ford specification ESA-M6C25-A (United States and Canada only). If DOT 3 is not available, use Ford High Performance DOT 4 Brake Fluid or equivalent meeting Ford specification SAE-J-1704-DOT 4.

- Do not reuse brake fluid drained or bled from the system.
- Do not use brake fluid that has been stored in an open container.
- Do not use contaminated brake fluid.

Front Disc Brake

Refer to Section 206-00 .

Brake Pads

Material

Item	Specification
High Performance DOT 3 Brake Fluid PM-1 (Canada CXC-31)	ESA-M6C25-A
High Performance DOT 4 Brake Fluid	FMVSS No. 116

Removal and Installation

⚠ WARNING: Use of any other than approved DOT 3 or DOT 4 brake fluid will cause permanent damage to brake components and will render the brakes inoperative.

⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

⚠ CAUTION: Brake fluid is harmful to painted or plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

1. Remove brake master cylinder filler cap. Check brake fluid level in brake master cylinder reservoir (2K478). Remove fluid until the reservoir is half full.

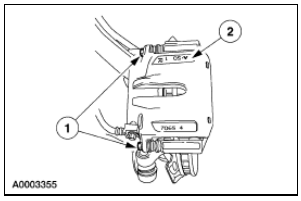
2. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

3. **⚠ CAUTION: Do not pry in caliper sight hole to retract pistons as this can damage the pistons and boots.**

   ⚠ CAUTION: When removing the caliper (2B120), never allow it to hang from the brake hose. Provide a suitable support.

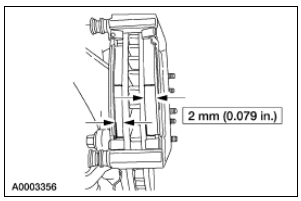
   Remove the brake caliper (2B120).

   1. Remove the caliper bolts.
   2. Lift the caliper off the caliper anchor plate (2B292).

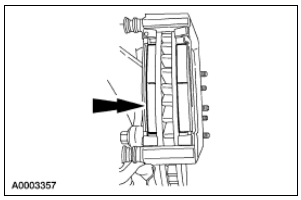


4. **⚠ CAUTION: Install new pads if worn to or past the specified thickness above the metal backing plate or rivets. Install new pads in complete axle sets.**

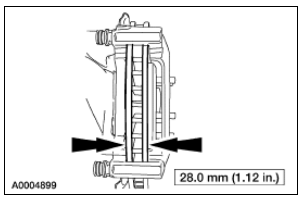
Inspect the pads (2100) for wear and contamination.



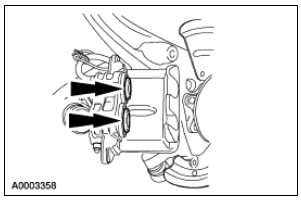
5. Remove the pads.



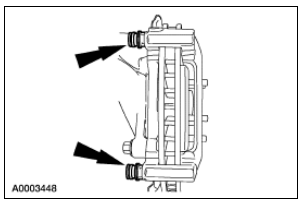
6. Measure the brake disc thickness.
   - Install a new brake disc (1125) if not within specification.



7. Inspect the caliper.
   - If leaks or damaged boots are found, disassembly is required. For additional information, refer to Brake Caliper in this section.

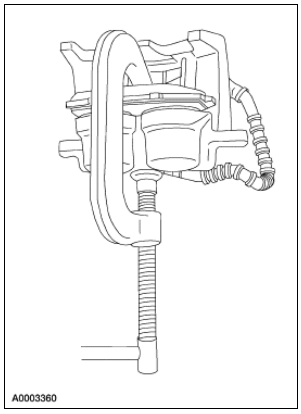


8. Inspect the anchor plate assembly.
   - Check the guide pin boots for damage.
   - Check the guide pins for binding and damage.
   - Install new pins if worn or damaged.

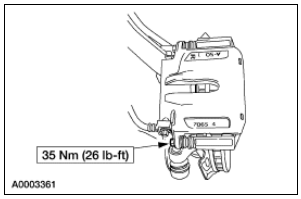


9. **NOTE:** Use a wood block or used pad to protect pistons and boots.

   Compress the caliper pistons.



10. To install, reverse the removal procedure.
    - Fill the brake master cylinder reservoir with clean brake fluid.



Brake Caliper

Material

Item	Specification
High Performance DOT 3 Brake Fluid PM-1 (Canada CXC-31)	ESA-M6C25-A
High Performance DOT 4 Brake Fluid	FMVSS No. 116

Removal and Installation

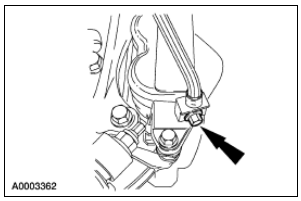
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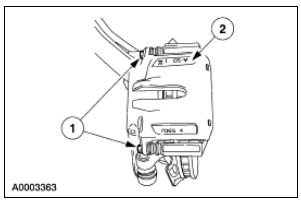
⚠ CAUTION: Brake fluid is harmful to painted or plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

1. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

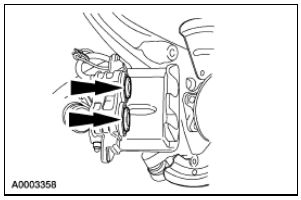
2. Remove the caliper flow bolt.
   - Discard the copper washers.



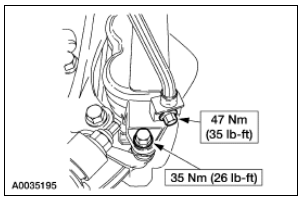
3. Remove the caliper (2B120).
   1. Remove the caliper bolts.
   2. Lift the caliper off the caliper anchor plate (2B292).



4. Inspect the caliper.
   - If leaks or damaged boots are found, disassembly is required. For additional information, refer to Brake Caliper in this section.



5. To install, reverse the removal procedure.
    - Install new copper washers.
    - Bleed the caliper. For additional information, refer to Section 206-00 .

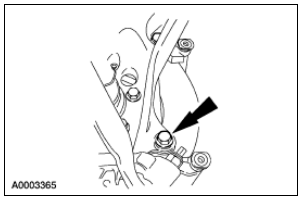


Brake Caliper Anchor Plate

Removal and Installation

1. Remove the pads (2100). For additional information, refer to Brake Pads in this section.

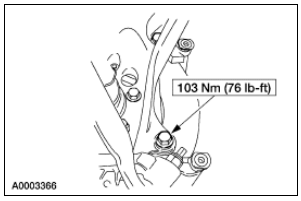
2. Remove the caliper anchor plate bolts.



3. ⚠ **CAUTION: Use correct type and length bolts.**

   To install, reverse the removal procedure.

   - Install new anchor plate bolts.



Brake Disc

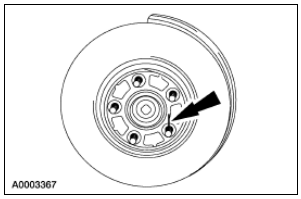
Material

Item	Specification
High Performance DOT 3 Brake Fluid PM-1 (Canada CXC-31)	ESA-M6C25-A
High Performance DOT 4 Brake Fluid	FMVSS No. 116
High Temperature Anti-Seize Lubricant XL-2	ESE-M12A4-A
Brake Parts Cleaner PM-4	F6AZ-2C410-AB
Rust Penetrant and Inhibitor XG-1-K	ESA-M1C75-B

Removal

1. Remove the caliper anchor plate (2B292). For additional information, refer to Brake Caliper Anchor Plate in this section.

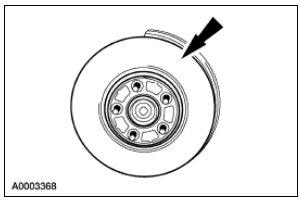
2. Mark the brake disc (1125) and a wheel stud.
   - This ensures the lowest brake disc runout is maintained during installation.



3. **⚠ CAUTION: If excessive force must be used during brake disc removal, the brake disc total indicated runout (TIR) must be checked at installation. For additional information, refer to Section 206-00 .**

   NOTE: If the brake disc cannot be removed easily, apply rust penetrant on the brake disc to wheel hub mating surfaces.

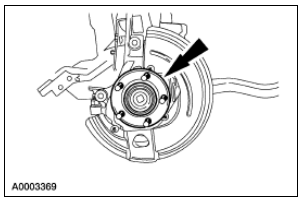
   Remove the brake disc.



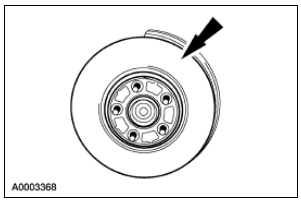
Installation

1. Clean any rust or foreign material from the brake disc and wheel hub.
    - Use brake parts cleaner to clean the brake disc and hub surfaces.

2. Apply anti-seize lubricant to the hub flange.



3. Align the hub and brake disc marks and position the brake disc to the wheel hub (1104).



4. Install the caliper anchor plate. For additional information, refer to Brake Caliper Anchor Plate in this section.

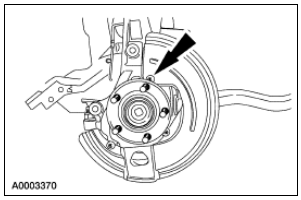
5. Check total indicated runout (TIR). For additional information, refer to Section 206-00 .

Brake Disc Shield

Removal and Installation

1. Remove the brake disc (1125). For additional information, refer to Brake Disc in this section.
2. ⚠ **CAUTION: Use a 5.5 mm (0.22 in) drill. DO NOT exceed past a 6 mm (0.24 in) drill.**

   Drill out the shield rivets.



3. To install, reverse the removal procedure.
   - Install new rivets.

Brake Caliper

Material

Item	Specification
High Performance DOT 3 Brake Fluid PM-1 (Canada CXC-31)	ESA-M6C25-A
High Performance DOT 4 Brake Fluid	FMVSS No. 116
Brake Parts Cleaner PM-4	F6AZ-2C410-AB

Disassembly

⚠ WARNING: Use of any other than approved DOT 3 or DOT 4 brake fluid will cause permanent damage to brake components and will render the brakes inoperative.

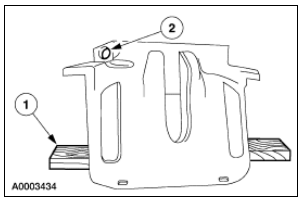
⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

⚠ CAUTION: Brake fluid is harmful to painted or plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

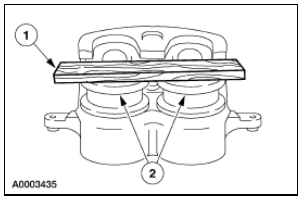
1. Remove the caliper (2B120). For additional information, refer to Brake Caliper in this section.

2. Drain the remaining brake fluid from caliper.

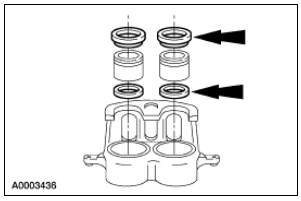
3. Apply low air pressure to the fluid port in the caliper.
    1. Place a block of wood between the caliper bridge and the caliper pistons (2196).
    2. Apply low air pressure to the fluid port in the caliper and force out the caliper pistons to the block of wood.



4. Remove the caliper pistons.
    1. Remove the block of wood.
    2. Remove the caliper pistons.



5. Remove and discard the piston seals (2B115) and boots (2207).



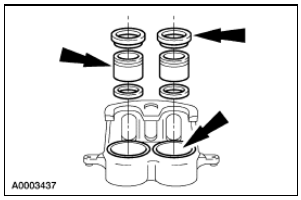
6. Remove and discard the bleed screw (2208) and cap.

Assembly

1. ⚠ **CAUTION: Do not hone the caliper bores. Caliper pistons are not available for honed caliper bores.**

   Clean and inspect the caliper pistons and the caliper.

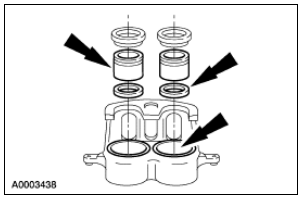
   - Remove dirt and debris.
   - Examine the caliper pistons for surface irregularities, scoring or wear. Install new caliper pistons if necessary.
   - Clean the caliper bores with brake parts cleaner.
     If the caliper bores are corroded or excessively scored, install a new caliper.
   - Lubricate the caliper pistons and piston seals before assembly.



2. ⚠ **CAUTION: Never reuse piston seals and dust boots.**

   NOTE: Never reuse brake fluid that has been drained from the hydraulic system or has been allowed to stand in an open container for an extended period of time.

   Lubricate the caliper piston, piston seal and caliper bores with clean brake fluid.



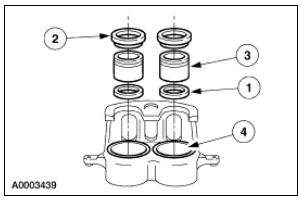
3. ⚠ **CAUTION: Pistons are not the same diameter.**

   Install the caliper piston.

1. Install the piston seal.
2. Install the piston boot on the piston.
3. ⚠ **CAUTION: Be careful not to damage or dislodge the piston seal.**

   Insert the caliper piston.
4. ⚠ **CAUTION: Be careful not to cock the caliper piston.**

   Press the caliper piston into the bore.



4. Install a new bleed screw and cap.

5. Install the caliper. For additional information, refer to Brake Caliper in this section.

General Specifications

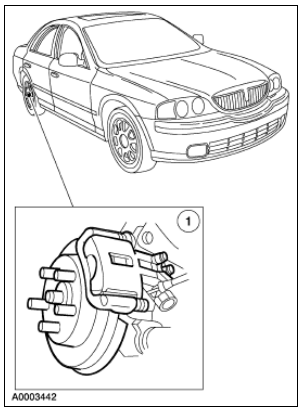
Item	Specification
Lining wear limit (from shoe surface)	1.0 mm (0.039 in)
Brake disc minimum thickness	18.50 mm (0.74 in)
Brake disc allowable runout on vehicle	0.102 mm (0.004 in)
Brake disc maximum thickness variation	0.01 mm (0.0004 in)
Fluids/Lubricants/Adhesives	
High Performance DOT 3 Brake Fluid PM-1 (Canada CXC-31)	ESA-M6C25-A
High Performance DOT 4 Brake Fluid	FMVSS No. 116
Brake Parts Cleaner PM-4	

Torque Specifications

Description	Nm	lb-ft
Caliper flow bolt	48	36
Support bracket bolts	103	76
Caliper bolts	33	25

Rear Disc Brake

Rear Disc Brake



Item	Part Number	Description
1	2B120	Rear disc brake caliper assy

The rear disc brake system consists of:

- solid, full-cast rear brake disc (1125).
- hydraulically activated rear disc brake caliper (2B120).

Brake Fluid

⚠ WARNING: Use of any other than approved DOT 4 or DOT 3 brake fluid will cause permanent damage to brake components and will render the brakes inoperative.

⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

⚠ CAUTION: Brake fluid is harmful to painted or plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

Use clean, fresh Ford High Performance DOT 3 Motor Vehicle Brake Fluid C6AZ-19542-AB or equivalent meeting Ford specification ESA-M6C25-A (United States and Canada only). If DOT 3 is not available, use Ford High Performance DOT 4 Brake Fluid or equivalent meeting Ford specification SAE-J-1704-DOT 4.

- Do not reuse brake fluid drained or bled from the system.
- Do not use brake fluid that has been stored in an open container.
- Do not use contaminated brake fluid.

Rear Disc Brake

Refer to Section 206-00 .

Brake Caliper

Removal and Installation

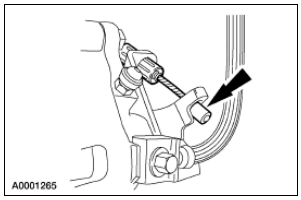
⚠ WARNING: Use of any other than approved DOT 3 or DOT 4 brake fluid will cause permanent damage to brake components and will render the brakes inoperative.

⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

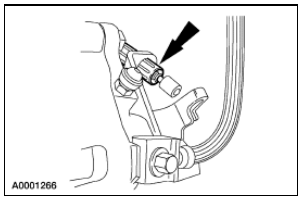
⚠ CAUTION: Brake fluid is harmful to painted or plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

1. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

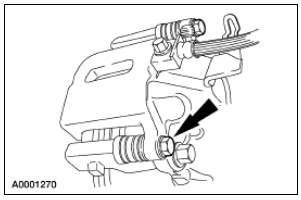
2. Remove the parking brake cable end from the parking brake lever arm.



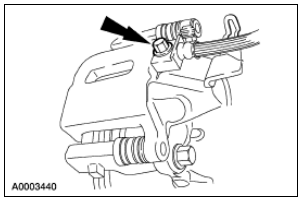
3. Remove the parking brake cable and conduit.



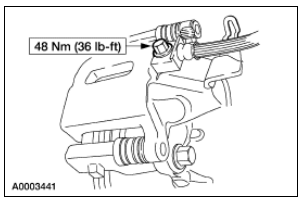
4. Remove the caliper bolts.

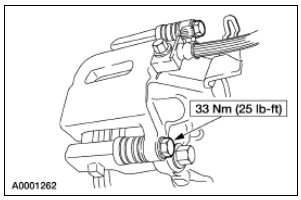


5. Remove the caliper flow bolt and remove the caliper (2552).
   - Discard the copper washers.



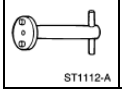
6. To install, reverse the removal procedure.
    - Use new copper washers.
        - ♦ Bleed the brake system. For additional information, refer to Section 206-00 .





Brake Pads

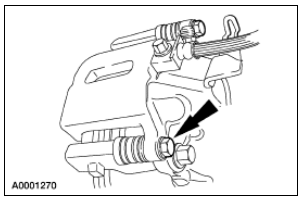
Special Tool(s)

 ST1112-A	Adapter for Adjuster, Rear Brake Caliper Piston 206-010 (T75P-2588-A)

Removal and Installation

1. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

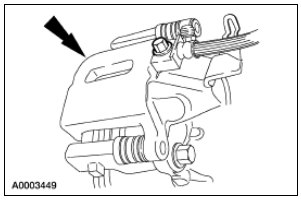
2. Remove the caliper bolts.


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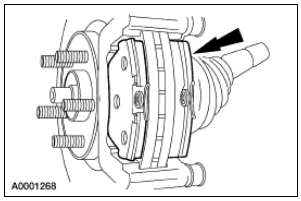
3. **⚠ CAUTION: Do not pry in caliper sight hole to retract pistons as this can damage the pistons and boots.**

   ⚠ CAUTION: When removing the caliper never allow it to hang from the brake hose. Provide a suitable support.

   Remove the caliper (2552).

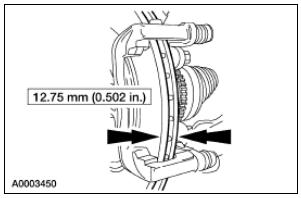

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4. Remove the brake pads (2100).

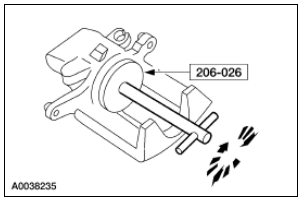

A0001268

5. **⚠ CAUTION: Use a hub-mount brake lathe if necessary to machine the brake disc.**

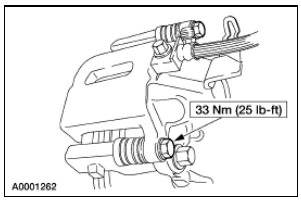
   Measure the brake disc (1125), and resurface as necessary. Install a new brake disc if beyond specification.



6. Compress the disc brake piston and adjuster into the disc brake caliper using Rear Caliper Piston Adjuster.



7. To install, reverse the removal procedure.



Brake Disc

Removal and Installation

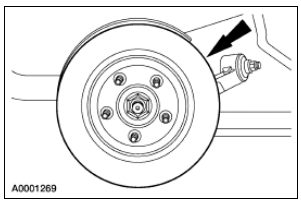
1. Remove the support bracket (2B511). For additional information, refer to Brake Caliper Support Bracket in this section.

2. **NOTE:** Remove and discard the pushnuts, if so equipped.

   NOTE: Mark the brake disc and a wheel stud.

   - This ensures that the lowest brake disc runout is maintained during installation.

   Remove the brake disc (1125).



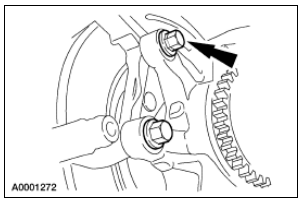
3. To install, reverse the removal procedure.

Brake Caliper Support Bracket

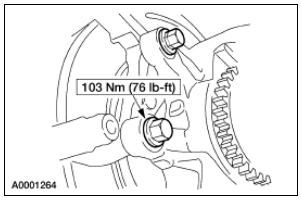
Removal and Installation

1. Remove the tire and wheel assembly. For additional information, refer to Section 204-04 .
2. ⚠ **CAUTION: When removing the caliper (2553), never allow it to hang from the brake hose. Provide a suitable support.**

   Remove brake pads (2100). For additional information, refer to Brake Pads in this section.
3. Remove the support bracket bolts.



4. To install, reverse the removal procedure.

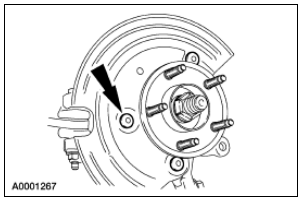


Brake Disc Shield

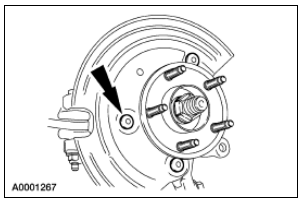
Removal and Installation

1. Remove the brake disc (1125). For additional information, refer to Brake Disc in this section.
2. ⚠ **CAUTION: Use a 5.5mm (0.22in) drill. DO NOT exceed past a 6mm (0.24in) drill.**

   Drill out the shield rivets.

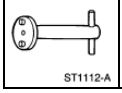


3. To install, reverse the removal procedure.
   - Install new rivets.



Brake Caliper

Special Tool(s)

 ST1112-A	Adapter for Adjuster, Rear Brake Caliper Piston 206-010 (T75P-2588-B)

Material

Item	Specification
High Performance DOT 3 Brake Fluid PM-1 (Canada CXC-31)	ESA-M6C25-A
Brake Parts Cleaner PM-4	F6AZ-2C410-AB

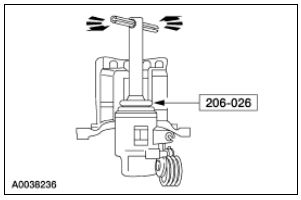
Disassembly

⚠ WARNING: Use of any other than approved DOT 3 or DOT 4 brake fluid will cause permanent damage to brake components and will render the brakes inoperative.

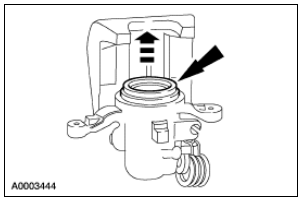
⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

⚠ CAUTION: Brake fluid is harmful to painted or plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

1. Remove the brake caliper (2B120). For additional information, refer to Brake Caliper in this section.
2. Drain the brake fluid from the brake caliper.
3. Secure the brake caliper in a vise.
4. Turn the brake piston counterclockwise with Rear Caliper Piston Adjuster.



5. Remove the brake piston from the caliper bore.



6. Remove and discard the piston dust boot and piston seal from the caliper bore.

Assembly

1. **⚠ CAUTION: Do not reuse piston seals or dust boots. Install new seals and dust boots or damage to the vehicle can occur.**

   ⚠ CAUTION: Do not hone the caliper bores. Caliper pistons are not available for honed caliper bores.

   NOTE: Use new brake fluid when assembling and bleeding the brake system.

   Clean and inspect the caliper pistons and the caliper.

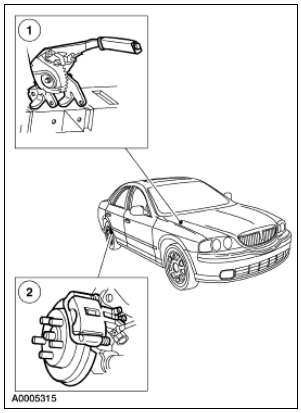
   - Remove dirt and debris.
   - Examine the caliper pistons for surface irregularities, scoring or wear. Install new caliper pistons if necessary.
   - Clean the caliper bores with brake parts cleaner.
     If the caliper bores are corroded or excessively scored, install a new caliper.
   - Lubricate the caliper pistons and piston seals with brake fluid before assembly.

2. To assemble, reverse the disassembly procedure.

Torque Specifications

Description	Nm	lb-ft
Parking brake control bolts/nuts	30	22
Parking brake control bolts/nuts	18	13
Brake hose clip mounting bolt	12	9

Parking Brake



Item	Part Number	Description
1	2780	Parking brake control
2	2552	Rear disc brake caliper

The parking brake system is cable-actuated and controlled by an independent hand-operated parking brake control. To apply parking brake, pull parking brake control upward.

The parking brake system is an AUTO-ADJUST system. The spring in the parking brake control continuously adjusts the cable tension in the system.

Brake Warning System

A brake warning indicator:

- is located in the instrument panel.
- illuminates to signal the driver the parking brake is applied.
- remains lit when a brake malfunction has occurred.

Parking Brake

Inspection and Verification

Check the operation of the parking brake system with the vehicle on a hoist and the parking brake control fully released. Check for any damaged cables and install new components as necessary. Check the rear brake adjustment or perform brake system diagnosis.

Check the parking brake by pulling up on the parking brake control. The parking brake must hold the vehicle on an incline, set by pulling up on the parking brake control before it reaches full travel. If not as specified, check the parking brake system for correct rear brake adjustment, cable operation and parking brake control operation.

Symptom Chart

Symptom Chart

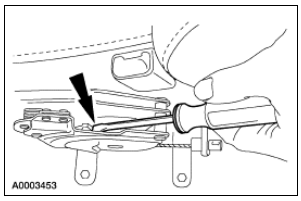
Parking Brake Control

Removal and Installation

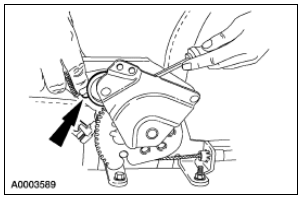
1. Remove the console. For additional information, refer to Section 501-12 .

2. **⚠ WARNING: The parking brake control will have spring tension on the tension arm and, if released inadvertently, can cause injury. Use care when working on or around the parking brake control when the tension arm is in the locked position. Failure to follow these instructions can cause personal injury.**

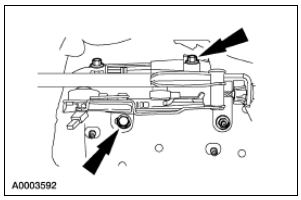
   Using a screwdriver, push down on the tension arm until it is fully depressed.



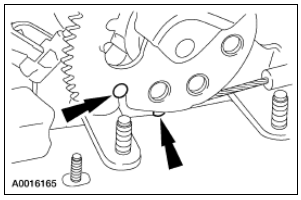
3. Move the tension arm down and release the screwdriver.



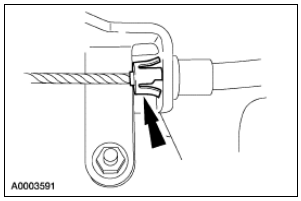
4. Remove the control retainers.
   - Disconnect the parking brake switch connector.



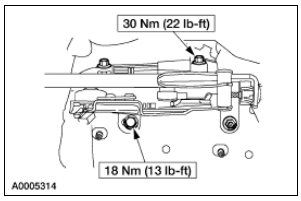
5. Bend the retaining tab out of the way and remove the cable anchor pin.



6. Using a 13 mm line wrench, depress the conduit retaining prongs to remove the parking brake cable and conduit from the control. Remove the parking brake control.



7. To install, reverse the removal procedure.

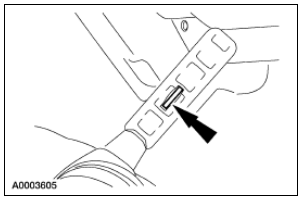


Parking Brake Cable Front

Removal and Installation

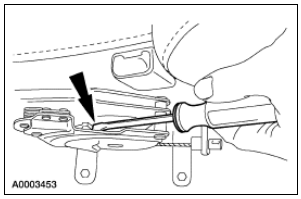
1. Remove the console. For additional information, refer to Section 501-12 .

2. Pull tab slide handle up.

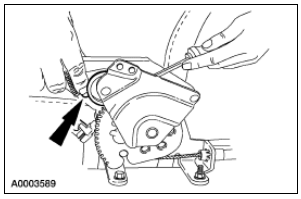


3. **⚠ WARNING: The parking brake control will have spring tension on the tension arm and, if released inadvertently, can cause injury. Use care when working on or around the parking brake control when the tension arm is in the locked position. Failure to follow these instructions can cause personal injury.**

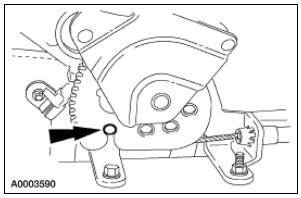
   Using a screwdriver, push down on the tension arm until it is fully depressed.



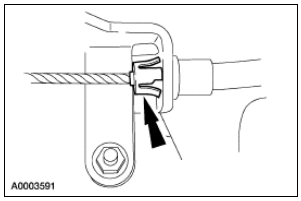
4. Move the tension arm down and release the screwdriver.



5. Remove the cable anchor pin.

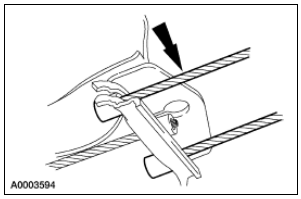


6. Using a 13 mm box-end wrench, depress the conduit retainer and remove the parking brake cable and conduit from the control.

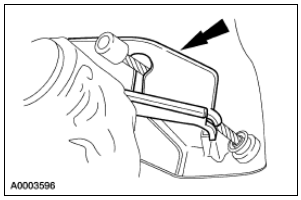


7. Raise and support the vehicle. For additional information, refer to Section 100-02 .

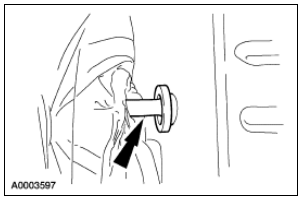
8. Disconnect the rear parking brake cables.



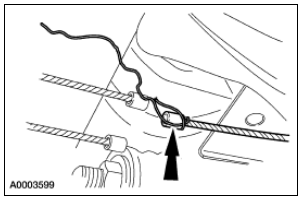
9. Remove the equalizer.



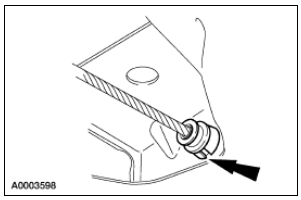
10. Snap the front cable grommet out of the floor and remove the cable.



11. Tie mechanics wire to the old cable and conduit to make installation of new cable easier.



12. Using a 13 mm box-end wrench, depress the conduit retaining prongs and remove the parking brake cable and conduit.



13. To install, reverse the removal procedure.

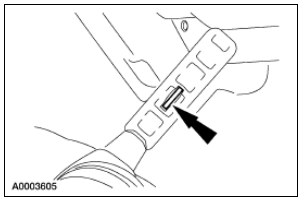
Parking Brake Cable Rear

Removal and Installation

NOTE: The RH rear is shown, the LH is similar.

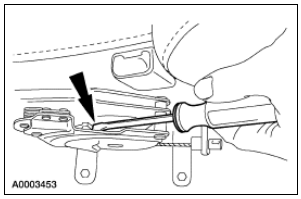
1. Remove the console. For additional information, refer to Section 501-12 .

2. Pull tab slide handle up.

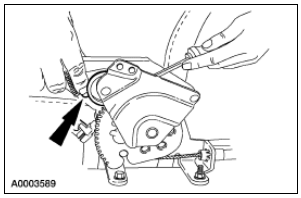


3. ⚠ **WARNING: The parking brake control will have spring tension on the tension arm and, if released inadvertently, can cause injury. U se care when working on or around the parking brake control when the tension arm is in the locked position. Failure to follow these instructions can cause personal injury.**

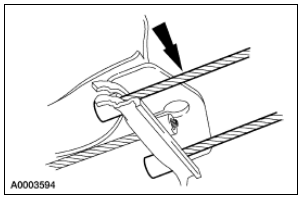
   Using a screwdriver, push down on the tension arm until it is fully depressed.



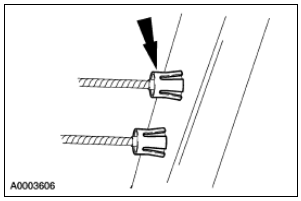
4. Move the tension arm down and release the screwdriver.



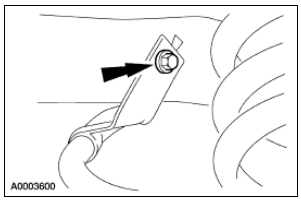
5. Disconnect the rear parking brake cables from the equalizer.



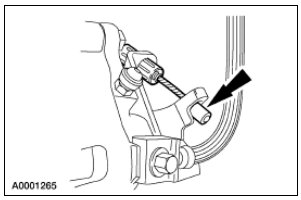
6. Using a 13 mm box-end wrench, depress the conduit retainer and remove the parking brake rear cable and conduit.



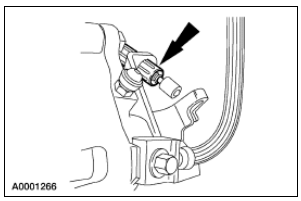
7. Remove the parking brake rear cable and conduit routing clip bolts.



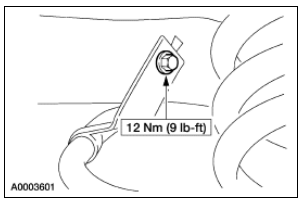
8. Disconnect the parking brake rear cable and conduit from the parking brake lever.



9. Using a 13 mm box-end wrench, depress the conduit retaining prongs and remove the parking brake rear cable and conduit.



10. To install, reverse the removal procedure.



General Specifications

Item	Specification
High Performance DOT 3 Brake Fluid PM-1 (Canada CXC-31)	ESA-M6C25-A
High Performance DOT 4 Brake Fluid	FMVSS No. 116

Torque Specifications

Description	Nm	lb-ft
Brake master cylinder nuts	30	22
Brake pedal bracket nuts	30	22
Strut tower brace nuts	28	21
Master cylinder brake tubes	13	10
Brake pedal bracket bolts	25	18

Hydraulic Brake Actuation

This vehicle is equipped with a brake pedal actuated dual brake system. The system consists of the following:

- power brake booster (2005)
- brake master cylinder (2140)
- disc brake calipers (2B120)
- rear disc brake calipers (2553)
- brake tubes and hoses
- anti-lock brake system (ABS) components

The dual ABS hydraulic system is diagonally split, with the LH front and RH rear making up one circuit and the RH front and LH rear making up the other circuit.

Brake Fluid

⚠ WARNING: Use of any other than approved DOT 3 or DOT 4 brake fluid will cause permanent damage to brake components and will render the brakes inoperative.

⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

⚠ CAUTION: Brake fluid is harmful to painted or plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

Use clean, fresh Ford High Performance DOT 3 Motor Vehicle Brake Fluid PM-1 (Canada CXC-31) or equivalent meeting Ford specification ESA-M6C25-A.

If DOT 3 is not available, use Ford High Performance DOT 4 brake fluid or equivalent meeting FMVSS No. 116.

- Do not reuse brake fluid drained or bled from the system.
- Do not use brake fluid that has been stored in an open container.
- Do not use contaminated brake fluid.

Brake Master Cylinder

The brake master cylinder is a dual piston type. The brake master cylinder operates as follows:

- When the brake pedal (2455) is depressed, pressure is applied by mechanical linkage to the primary and secondary piston.
- Brake master cylinder pistons apply hydraulic pressure to the two opposed hydraulic circuits.
- Brake master cylinder cannot be overhauled, install a new master cylinder only.

The brake master cylinder consists of:

- brake master cylinder reservoir (2K478)
- brake master cylinder body

Brake Master Cylinder Reservoir

NOTE: Whenever the brake master cylinder reservoir is removed from the brake master cylinder, new grommets must be installed.

The brake master cylinder reservoir:

- is mounted to the brake master cylinder.
- holds fluid supply for each brake master cylinder hydraulic piston.
- provides visual fluid level markings.
- contains the brake master cylinder fluid level sensor.

Brake Tubes and Hoses

⚠ CAUTION: Never use copper tubing. It is subject to fatigue, cracking and corrosion, which could result in brake tube failure.

If a section of brake tube is damaged, install a new section of tube the same type, size, shape and length.

When installing hydraulic brake tubing, hoses, or connectors, tighten all connections securely. After installation, bleed the brake system. For additional information, refer to Section 206-00 .

Hydraulic Brake Actuation

Refer to Section 206-00 .

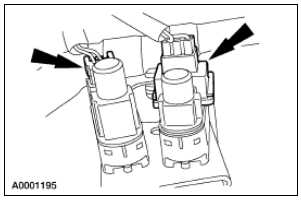
Brake Pedal And Bracket

Removal

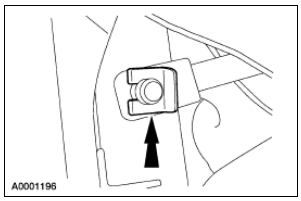
1. **NOTE:** LH shown, RH similar.

   Disconnect the battery ground cable (14301). For additional information, refer to Section 414-01 .

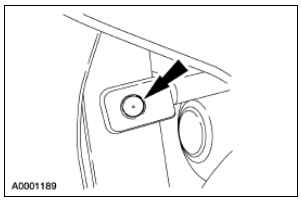
2. Disconnect the stoplight and cruise switch electrical connectors.



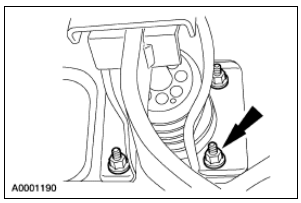
3. Remove the brake pedal pin clip.



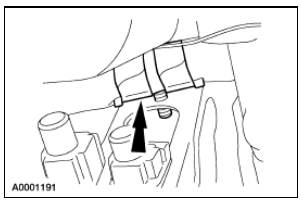
4. Remove the brake pedal pin.



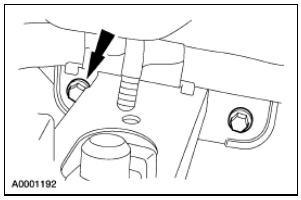
5. Remove the four brake pedal bracket nuts.



6. Remove the wiring harness pushpin.

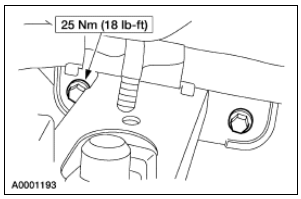


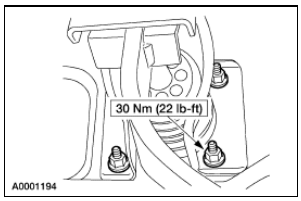
7. Remove the brake pedal bracket bolts and remove the brake pedal and bracket (2455).



Installation

1. To install, reverse the removal procedure.





Brake Master Cylinder

Removal and Installation

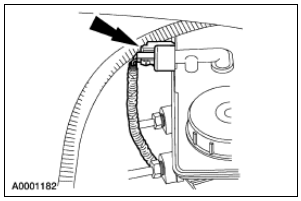
All vehicles

⚠ WARNING: Use of any other than approved DOT 4 or DOT 3 brake fluid will cause permanent damage to brake components and will render the brakes inoperative.

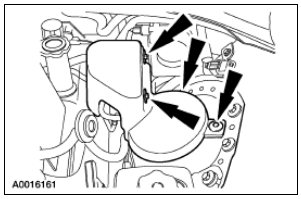
⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

⚠ CAUTION: Brake fluid is harmful to painted or plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

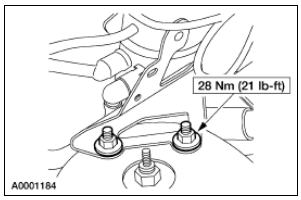
1. Disconnect the fluid level sensor connector.



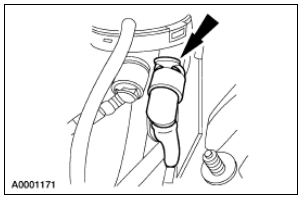
2. Remove the retainers and left upper shock mount cover.



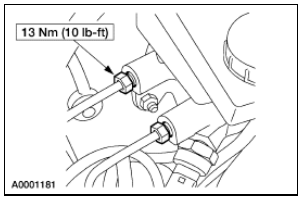
3. Remove the vapor management valve (VMV) nuts.



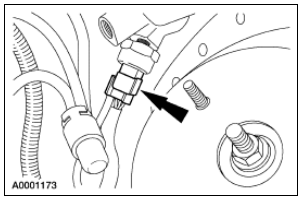
4. Disconnect the (VMV) hose and position valve aside.



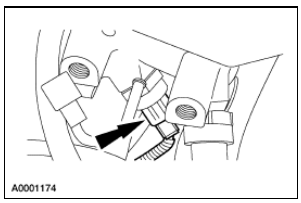
5. Disconnect the brake tubes.



6. Disconnect the brake master cylinder IVD transducer electrical connector (as applicable).

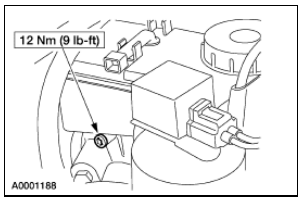


7. Disconnect the brake master cylinder IVD transducer electrical connector (as applicable).



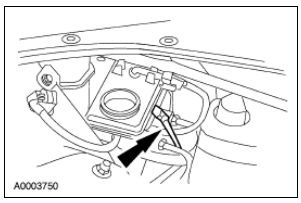
8. Use a suitable suction device to drain the brake master cylinder reservoir.

9. Remove the reservoir bolt.



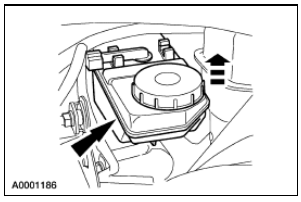
Vehicles with manual transmission

10. Remove the hose at the clutch master cylinder reservoir.

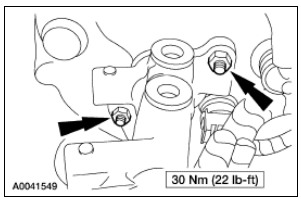


All vehicles

11. Remove the reservoir.



12. Remove the brake master cylinder nuts and remove the brake master cylinder.



13. To install, reverse the removal procedure.
    - Bleed the brake system. For additional information, refer to Section 206-00 .

Brake Fluid Reservoir

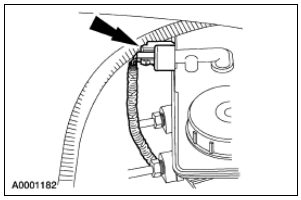
Removal and Installation

⚠ WARNING: Use of any other than approved DOT 4 or DOT 3 brake fluid will cause permanent damage to brake components and will render the brakes inoperative.

⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

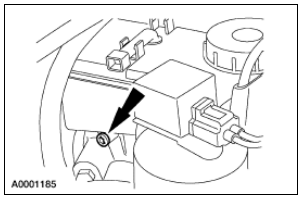
⚠ CAUTION: Brake fluid is harmful to painted or plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

1. Disconnect the brake master cylinder fluid level sensor connector.

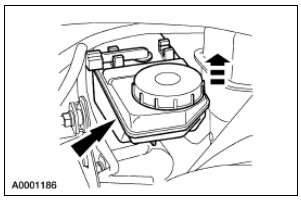


2. Use a suitable suction device to drain the brake master cylinder reservoir (2K478).

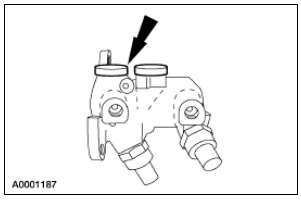
3. Remove the reservoir screw.



4. Remove the reservoir.



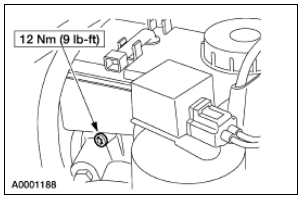
5. Remove the reservoir grommets.



6. **NOTE:** Whenever installing a new brake master cylinder reservoir, install new grommets.

To install, reverse the removal procedure.

- Use clean, fresh Ford High Performance DOT 3 Motor Vehicle Brake Fluid C6AZ-19542-AB or equivalent meeting Ford specification ESA-M6C25-A (United States and Canada only). If DOT 3 is not available, use Ford High Performance DOT 4 Brake Fluid or equivalent meeting Ford specification SAE-J-1704-DOT 4.

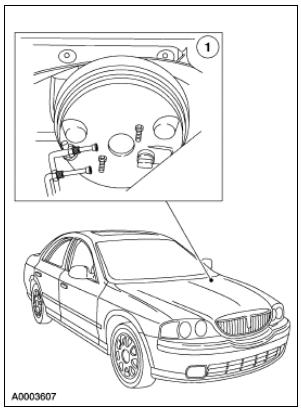


Torque Specifications

Description	Nm	lb-ft
Coolant reservoir bolts	15	11
Cowl brace end bolts	20	15
Cowl brace nuts	20	15
Power brake booster nuts	30	22
Vacuum hose bracket nut	15	11
Wiper arm nuts	35	26

Brake Booster

Power Brake Booster



Item	Part Number	Description
1	2005	Brake vacuum booster

The power brake booster (2005):

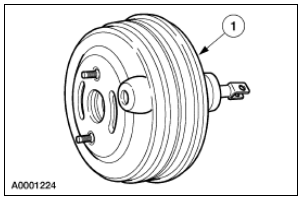
- is a dual diaphragm, vacuum assisted power brake booster.
- reduces brake pedal pressure and travel distance.
- is located on the bulkhead in the engine compartment, between the brake pedal and brake master cylinder (2140).
- is divided into separate chambers by the diaphragm.
- will not operate if vacuum is restricted or if any of the vacuum related power brake components fail.
- is installed as an assembly.

If the power assist fails, the brake system will continue to operate with increased brake pedal effort.

Hose and Check Valve

The power brake booster check valve:

- is located on the front of the power brake booster.
- is positioned between the power brake booster and the power brake booster hose.
- closes when the engine is turned off.
- in the closed position, traps engine vacuum in the power brake booster.
- retains vacuum to provide several power assisted brake applications with the engine off.



Item	Part Number	Description
1	2005	Brake vacuum booster

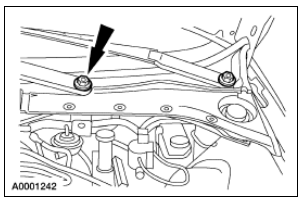
Power Brake System

Refer to Section 206-00 .

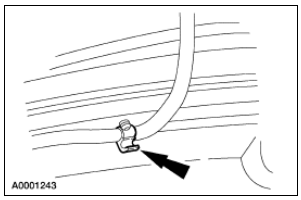
Brake Booster

Removal

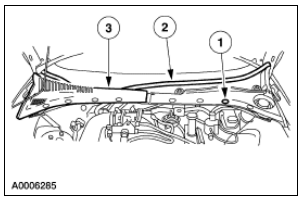
1. Remove the wiper arm nuts and remove wiper arms.



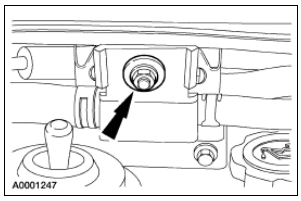
2. Disconnect the washer hose.



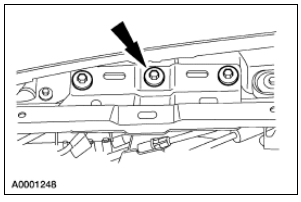
3. Remove the cowl cover.
    1. Remove the cowl cover pushpins.
    2. Remove the cowl cover rubber trim.
    3. Remove the cowl cover.



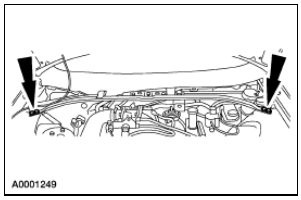
4. Remove the vacuum hose bracket nut and position bracket aside.



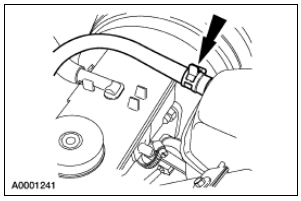
5. Remove the cowl brace center bolts.



6. Remove the cowl brace end bolts and remove the bracket.

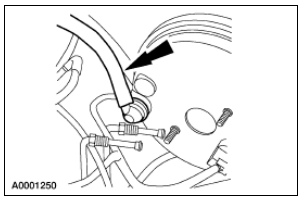


7. Disconnect the coolant reservoir return hose.

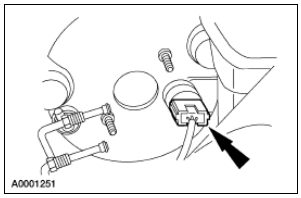


8. Remove the brake master cylinder. For additional information, refer to Section 206-06

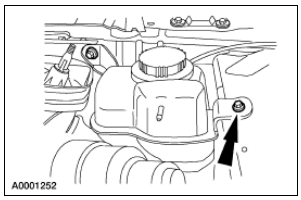
9. Disconnect the power brake booster check valve.



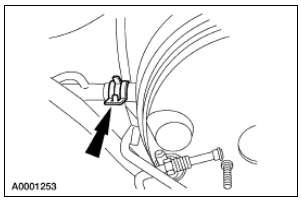
10. Disconnect the power brake booster electrical connector (as applicable).



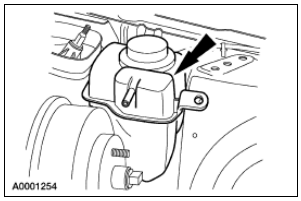
11. Remove the coolant reservoir bolts.



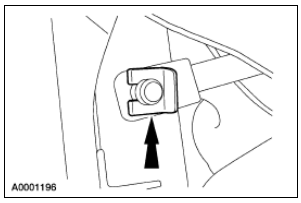
12. Disconnect the radiator to engine vent.



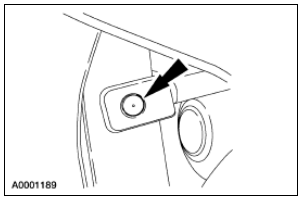
13. Remove the coolant reservoir.



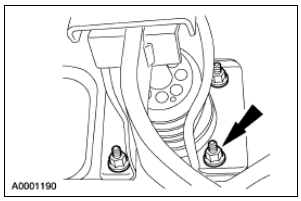
14. Remove the clip from the brake pedal pin.



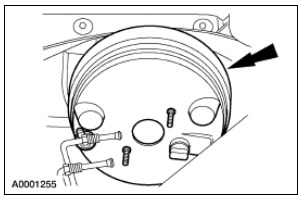
15. Remove the brake pedal pin.



16. Remove the booster nuts.

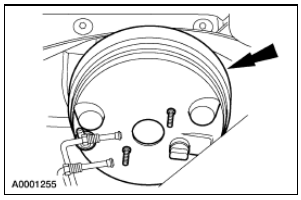


17. Remove the power brake booster.

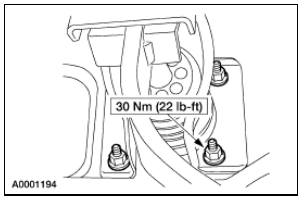


Installation

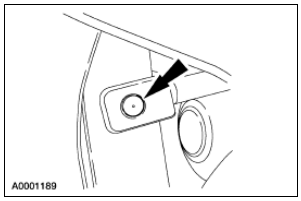
1. Install the power brake booster.



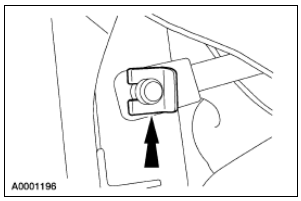
2. Install the booster nuts.



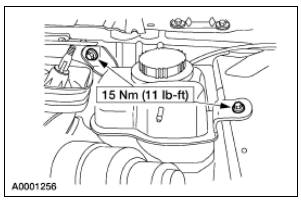
3. Install the brake pedal pin.



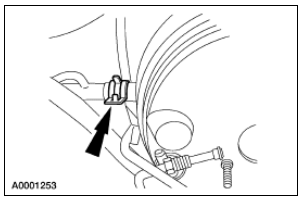
4. Install the clip on the brake pedal pin.



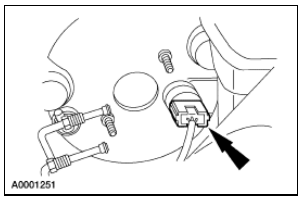
5. Install the radiator coolant recovery reservoir bolts.



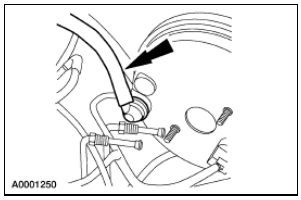
6. Connect the coolant reservoir hose.



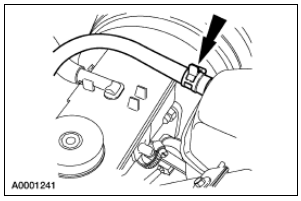
7. Connect the power brake booster electrical connector (as applicable).



8. Connect the power brake booster check valve.

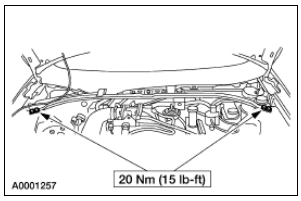


9. Connect the coolant reservoir return hose.

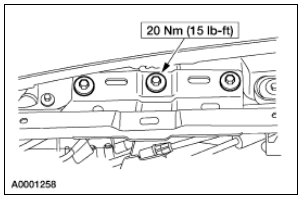


10. Install the brake master cylinder. For additional information, refer to Section 206-06 .

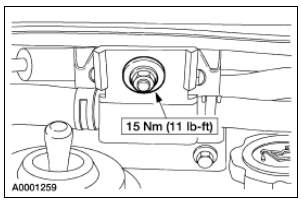
11. Install the cowl brace end bolts.



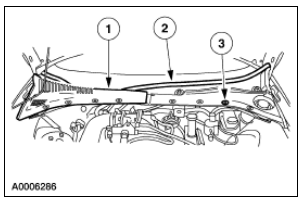
12. Install the cowl brace center bolts.



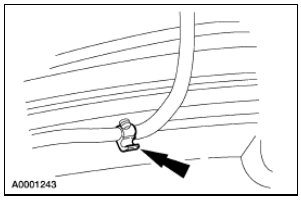
13. Install the vacuum hose bracket nut.



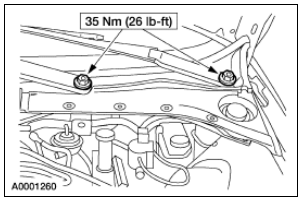
14. Install the cowl cover.
    1. Install the cowl cover.
    2. Install the cowl cover rubber trim.
    3. Install the cowl cover pushpins.



15. Connect the washer hose.



16. Install the wiper arm nuts.



17. Bleed brake system. For additional information, refer to Section 206-00 .

18. Check the coolant level. Fill as necessary. For additional information, refer to Section 303-03 .

General Specifications

Item	Specification
High Temperature 4X4 Front Axle and Wheel Bearing Grease E8TZ-19590-A	ESA-M1C198-A
RTV Silicone Sealant F5TZ-19G204-AB (Canada CXC-114A)	NAVSTR Sealer

Torque Specifications

Description	Nm	lb-ft	lb-in
Anti-lock brake control module bolts	2		18
Brake line to (HCU) nuts	18	13	
Electronic hydraulic control unit bolts	11	8	
Rear anti-lock brake sensor bolt	9		80

Anti-Lock Control

The four wheel anti-lock brake system (4WABS) consists of the following components:

- anti-lock brake module
- front anti-lock brake sensors
- front anti-lock brake sensor indicators
- hydraulic control unit (HCU)
- rear anti-lock brake sensors
- rear anti-lock brake sensor indicators
- yellow anti-lock brake warning indicator

For removal and installation of the front anti-lock brake sensor indicators, refer to Section 204-01 .

For removal and installation of the rear anti-lock brake sensor indicators, refer to Section 205-05 .

Anti-Lock Control

Refer to Wiring Diagrams Cell 42 , ABS for schematic and connector information.

Special Tool(s)

 ST1137-A	73 III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
 ST2574-A	Flex Probe Kit 105-R025B

Principles of Operation

The anti-lock-brake control module receives wheel speed readings from each anti-lock brake sensor and processes this information to determine if an ABS event is necessary. The anti-lock brake sensor electrically senses each tooth of the anti-lock brake sensor indicators as it passes through the anti-lock brake sensor magnetic field.

The anti-lock brake control module continuously monitors and compares the rotational speed of each wheel and, when it detects an impending wheel lock, modulates brake pressure to the appropriate brake caliper. This is accomplished by triggering the hydraulic control unit (HCU) to open and close the appropriate solenoid valves. Once the affected wheel returns to normal speed, the anti-lock brake control module returns the solenoid valves to their normal position, and normal (base) braking resumes.

The anti-lock brake control module is self-monitoring. When the ignition switch is turned to the RUN position, the anti-lock brake control module will do a preliminary electrical check, and at approximately 20 km/h (12 mph) the pump motor is turned on for approximately one half-second. Any malfunction of the ABS will cause the ABS to shut off and the yellow anti-lock brake warning indicator to illuminate; normal power assisted braking, however, remains.

Inspection and Verification

1. Verify the customer concern by applying the brakes under different conditions.

2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Anti-lock brake sensor indicator • Base brake concerns • HCU • Tire pressure • Tire size or mismatched tires	• Underhood auxiliary junction box (AJB) Maxifuses: ♦ 114 (30A) ♦ 122 (30A) • Central junction box (CJB) Fuse: ♦ 203 (5A) • Anti-lock brake control module • Anti-lock brake sensors • Brake pedal position (BPP) switch • Circuitry • Connectors or connections • EVAC and fill connector • Wire harness routing

3. If the fault is not visually evident, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If the scan tool still does not communicate with the vehicle, refer to the New Generation STAR Tester manual.

5. Carry out the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:
   - CKT914, CKT915, or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for anti-lock brake control module, go to Pinpoint Test A.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out the self-test diagnostics for the anti-lock brake control module.

6. If the DTCs retrieved are related to the concern, go to Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart.

Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index

Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1342	ECU is Defective	Anti-Lock Brake Control Module	INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module .
B1485	Brake Pedal Input Circuit Battery Short	Anti-Lock Brake Control Module	Go To Pinpoint Test B .
B1676			Go To Pinpoint Test C .

	Battery Pack Voltage Out of Range	Anti-Lock Brake Control Module	
B2477	Module Configuration Failure	Anti-Lock Brake Control Module	CONFIGURE the anti-lock brake control module; REFER to Section 418-01 . CLEAR the DTCs. REPEAT the self-test. If DTC B2477 is retrieved again, INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module . REPEAT the self-test.
C1095	Hydraulic Pump Motor Circuit Failure	Anti-Lock Brake Control Module	Go To Pinpoint Test D .
C1145	Speed Wheel Sensor RF Input Circuit Failure	Anti-Lock Brake Control Module	Go To Pinpoint Test E .
C1155	Speed Wheel Sensor LF Input Circuit Failure	Anti-Lock Brake Control Module	Go To Pinpoint Test E .
C1165	Speed Wheel Sensor RR Input Circuit Failure	Anti-Lock Brake Control Module	Go To Pinpoint Test E .
C1175	Speed Wheel Sensor LR Input Circuit Failure	Anti-Lock Brake Control Module	Go To Pinpoint Test E .
C1233	Speed Wheel LF Input Signal Missing	Anti-Lock Brake Control Module	Go To Pinpoint Test F .
C1234	Speed Wheel RF Input Signal Missing	Anti-Lock Brake Control Module	Go To Pinpoint Test F .
C1235	Speed Wheel RR Input Signal Missing	Anti-Lock Brake Control Module	Go To Pinpoint Test F .
C1236	Speed Wheel LR Input Signal Missing	Anti-Lock Brake Control Module	Go To Pinpoint Test F .

Symptom Chart

NOTE: Refer to the wiring diagrams for connector numbers stated in the pinpoint tests.

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE ANTI-LOCK BRAKE CONTROL MODULE

PINPOINT TEST B: DTC B1485 , BRAKE PEDAL INPUT CIRCUIT BATTERY SHORT

PINPOINT TEST C: DTC B1676, BATTERY PACK VOLTAGE OUT OF RANGE

PINPOINT TEST D: DTC C1095, HYDRAULIC PUMP MOTOR CIRCUIT FAILURE

PINPOINT TEST E: DTC C 1145 (RF), DTC C1155 (LF), DTC C1165 (RR), DTC C1175 (LR), ANTI-LOCK BRAKE SENSOR CIRCUIT FAILURE

PINPOINT TEST F: DTC C1233 (LF), DTC C1234 (RF), DTC C1235 (RR), DTC C1236 (LR) ANTI-LOCK BRAKE SENSOR INPUT SIGNAL MISSING

PINPOINT TEST G: THE YELLOW ANTI-LOCK BRAKE WARNING INDICATOR DOES NOT SELF-CHECK

Hydraulic Control Unit (HCU)

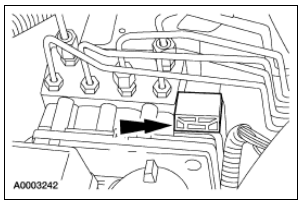
Removal and Installation

⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

⚠ CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

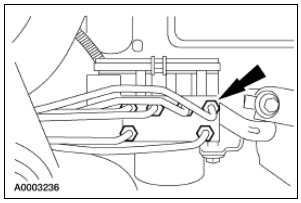
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Disconnect the electrical connector by lifting up on the release tab.

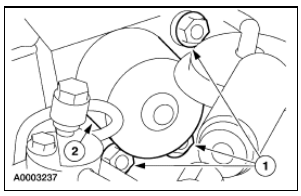


3. **NOTE:** Plug each open port to prevent any brake fluid from spilling.

   Disconnect the brake lines from the hydraulic control unit (HCU).



4. Remove the HCU.
   1. Remove the bolts.
   2. Remove the HCU.



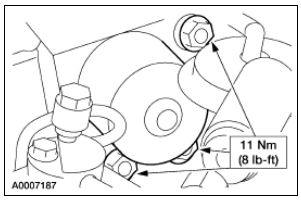
5. **⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.**

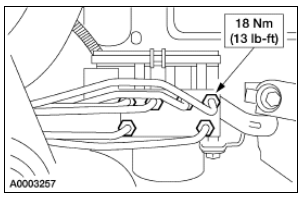
   ⚠ CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

⚠ CAUTION: After the HCU is installed, it is necessary to bleed the hydraulic brake system. For additional information, refer to Section 206-00 .

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

To install, reverse the removal procedure.



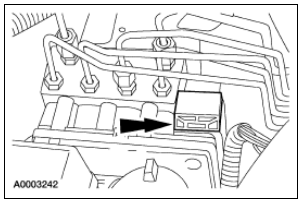


Anti-Lock Brake System (ABS) Module

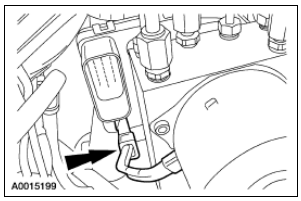
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

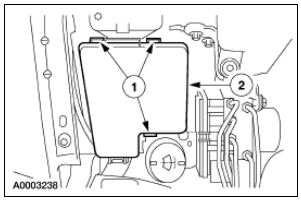
2. Disconnect the anti-lock brake control module electrical connector.



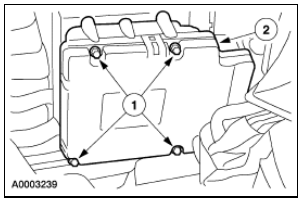
3. Disconnect the anti-lock brake pump motor electrical connector.



4. Position the underhood auxiliary junction box (AJB) aside.
    1. Release the underhood AJB clips.
    2. Position the underhood AJB aside.



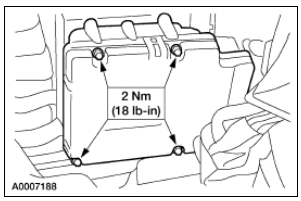
5. Remove the anti-lock brake control module.
    1. Remove the bolts.
    2. Remove the control module.



6. ⚠ **CAUTION: Once the new module is installed, it is necessary to download the module configuration information from the scan tool into the module. For additional information, refer to Section 418-01 .**

   NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

To install, reverse the removal procedure.



Front Wheel Speed Sensor

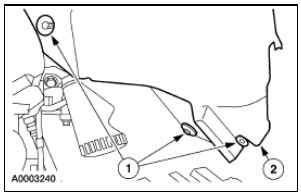
Material

Item	Specification
RTV Silicone Sealant FSTZ-19G204-AB (Canada CXC-114A)	NAVSTR Sealer

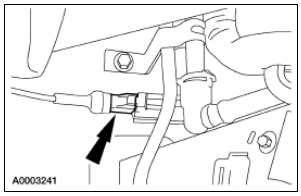
Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

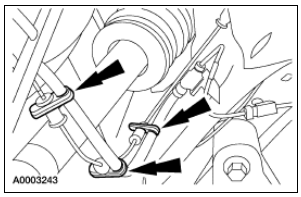
2. Position the inner splash shield aside.
    1. Remove the pin-type retainers.
    2. Position the inner splash shield aside.



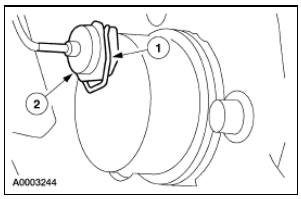
3. Disconnect the anti-lock brake sensor electrical connector.



4. Remove the anti-lock brake sensor harness from the brake hose clips.



5. Remove the anti-lock brake sensor.
    1. Remove the anti-lock brake sensor clip.
    2. Remove the anti-lock brake sensor.



6. **NOTE:** Make sure the anti-lock brake sensor is fully seated before installation of the new clip.

To install, reverse the removal procedure.

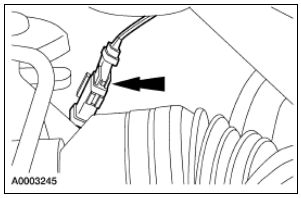
- Apply a 2.5 mm (0.1 in) bead of silicone sealant to the outside diameter of the anti-lock brake sensor.

Rear Wheel Speed Sensor

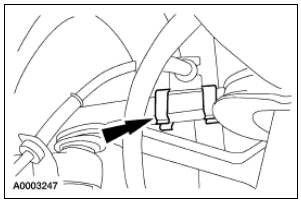
Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Disconnect the rear anti-lock brake sensor electrical connector.



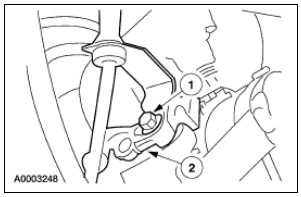
3. Remove the rear anti-lock brake sensor harness from the control arm clips.



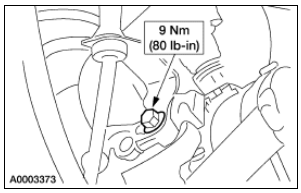
4. **NOTE:** Clean off dirt and foreign material that may have collected around the rear anti-lock brake sensor before removal.

   Remove the rear anti-lock brake sensor.

   1. Remove the anti-lock brake sensor bolt.
   2. Remove the anti-lock brake sensor.



5. To install, reverse the removal procedure.



General Specifications

Item	Specification
High Temperature 4X4 Front Axle and Wheel Bearing Grease E8TZ-19590-A	ESA-M1C198-A
RTV Silicone Sealant F5TZ-19G204-AB (Canada CXC-114A)	NAVSTR Sealer

Torque Specifications

Description	Nm	lb-ft	lb-in
Anti-lock brake control module bolts	2		18
Brake line to (HCU) nuts	18	13	
Electronic hydraulic control unit bolts	11	8	
Rear anti-lock brake sensor bolt	9		80

Anti-Lock Control Traction Control

The four wheel anti-lock brake system (4WABS) with traction control consists of the following components:

- anti-lock brake control module
- front anti-lock brake sensors
- front anti-lock brake sensor indicators
- hydraulic control unit (HCU)
- rear anti-lock brake sensors
- rear anti-lock brake sensor indicators
- traction control event indicator
- traction control switch
- yellow anti-lock brake warning indicator

For removal and installation of the front anti-lock brake sensor indicators, refer to Section 204-01 .

For removal and installation of the rear anti-lock brake sensor indicators, refer to Section 205-05 .

Anti-Lock Control Traction Control

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
 ST2574-A	Flex Probe Kit 105-R025B

Refer to Wiring Diagrams Cell 42 , ABS for schematic and connector information.

Principles of Operation

The anti-lock-brake control module receives wheel speed readings from each anti-lock brake sensor and processes this information to determine if an ABS event is necessary. The anti-lock brake sensor electrically senses each tooth of the anti-lock brake sensor indicators as it passes through the anti-lock brake sensor magnetic field.

The anti-lock brake control module continuously monitors and compares the rotational speed of each wheel and, when it detects an impending wheel lock, modulates brake pressure to the appropriate brake caliper. This is accomplished by triggering the hydraulic control unit (HCU) to open and close the appropriate solenoid valves. Once the affected wheel returns to normal speed, the anti-lock brake control module returns the solenoid valves to their normal position, and normal (base) braking resumes.

The anti-lock brake control module is self-monitoring. When the ignition switch is turned to the RUN position, the anti-lock brake control module will do a preliminary electrical check, and at approximately 20 km/h (12 mph) the pump motor is turned on for approximately one half-second. Any malfunction of the ABS will cause the ABS or anti-lock brake system/traction control (ABS/TC) to shut off and the yellow anti-lock brake warning indicator to illuminate, however the power assist braking system functions normally.

The anti-lock brake control module and traction control communicates with the powertrain control module (PCM) to assist with traction control. At speeds under 40 km/h (25 mph) the anti-lock brake control module requests the PCM to reduce engine torque, while simultaneously applying and releasing the appropriate brake to restore traction when one or both drive wheels lose traction and begin to spin. The PCM accomplishes this by minor incremental timing changes and fewer fuel injector pulses until the anti-lock brake control module ends the request (when driven wheel speed returns to normal). After the vehicle speed exceeds 40 km/h (25 mph), the traction control is accomplished only through the PCM torque control.

If the traction control system is cycled excessively, the brake portion of the system will shut down to prevent the rear brakes from overheating. A limited traction control function using only engine torque reduction will

still control the wheels from over-spinning. When the rear brakes have cooled down the system will again function normally. Anti-lock braking is not affected by this condition and will function normally during the cool down period.

The traction control system can be disabled by depressing the traction control switch. The traction control system will reset and return to normal traction assist when the ignition switch is cycled or when the traction control switch is depressed again.

Inspection and Verification

NOTE: The anti-lock brake control module must be reconfigured upon replacement; refer to Section 418-01 .

1. Verify the customer concern by applying the brakes under different conditions.

2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Anti-lock brake sensor indicator • Base brake concerns • HCU • Tire pressure • Tire size or mismatched tires	• Underhood auxiliary junction box (AJB) Maxi Fuses: ♦ 114 (30A) ♦ 122 (30A) • Central junction box (CJB) Fuses: ♦ 205 (5A) ♦ 203 (5A) • Anti-lock brake control module • Anti-lock brake sensors • Brake pedal position (BPP) switch • Circuitry • Connectors or connections • EVAC and fill connector • Traction control switch • Wire harness routing

3. If the fault is not visually evident, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the scan tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If the scan tool still does not communicate with the vehicle, refer to the scan tool manual.

5. Carry out the DATA LINK DIAGNOSTIC TEST. If the scan tool responds with:
   - CKT914, CKT915, or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for anti-lock brake control module, go to Pinpoint Test A.

- SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out the self-test diagnostics for the anti-lock brake control module.

6. If the DTCs retrieved are related to the concern, go to Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart.

Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1342	ECU is Defective	Anti-Lock Brake Control Module	INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module .
B1485	Brake Pedal Input Circuit Battery Short	Anti-Lock Brake Control Module	Go To Pinpoint Test B .
B1676	Battery Pack Voltage Out of Range	Anti-Lock Brake Control Module	Go To Pinpoint Test C .
B2477	Module Configuration Failure	Anti-Lock Brake Control Module	CONFIGURE the anti-lock brake control module; REFER to Section 418-01 . CLEAR the DTCs. REPEAT the self-test. If DTC B2477 is retrieved again, INSTALL a new anti-lock brake control module; REFER to Anti-Lock Brake System (ABS) Module . REPEAT the self-test.
C1095	Hydraulic Pump Motor Circuit Failure	Anti-Lock Brake Control Module	Go To Pinpoint Test D .
C1145	Speed Wheel Sensor RF Input Circuit Failure	Anti-Lock Brake Control Module	Go To Pinpoint Test E .
C1155	Speed Wheel Sensor LF Input Circuit Failure	Anti-Lock Brake Control Module	Go To Pinpoint Test E .
C1165	Speed Wheel Sensor RR Input Circuit Failure	Anti-Lock Brake Control Module	Go To Pinpoint Test E .
C1175	Speed Wheel Sensor LR Input Circuit Failure	Anti-Lock Brake Control Module	Go To Pinpoint Test E .

C1233	Speed Wheel LF Input Signal Missing	Anti-Lock Brake Control Module	Go To Pinpoint Test F .
C1234	Speed Wheel RF Input Signal Missing	Anti-Lock Brake Control Module	Go To Pinpoint Test F .
C1235	Speed Wheel RR Input Signal Missing	Anti-Lock Brake Control Module	Go To Pinpoint Test F .
C1236	Speed Wheel LR Input Signal Missing	Anti-Lock Brake Control Module	Go To Pinpoint Test F .
P0112	IAT Circuit Low Input	PCM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0122	TP Sensor A Circuit Low Input	PCM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0123	TP Sensor A Circuit High Input	PCM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0500	Vehicle Speed Sensor Malfunction	PCM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0501	Vehicle Speed Sensor Range/Performance	PCM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0502	Vehicle Speed Sensor Low Input	PCM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P0503	Vehicle Speed Sensor Intermittent	PCM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1120	TP Sensor Out Of Range Low (Ratch Too Low)	PCM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1183	Engine Oil Temperature Circuit Malfunction	PCM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1184	Engine Oil Temperature Out Of Self Test Range	PCM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1009	SCP (J1850) Invalid or Missing Data for Engine Torque	ABS/TC	CARRY OUT the PCM self-test.
U1027	SCP (J1850) Invalid or Missing Data for Engine RPM	ABS/TC	CARRY OUT the PCM self-test.
U1262	SCP (J1850) Communication Bus Fault	ABS/TC	REFER to Section 418-00 .

Symptom Chart

NOTE: Refer to the wiring diagrams for connector numbers stated in the pinpoint tests.

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE ANTI-LOCK BRAKE CONTROL MODULE

PINPOINT TEST B: DTC B1485 , BRAKE PEDAL INPUT CIRCUIT BATTERY SHORT

PINPOINT TEST C: DTC B1676, BATTERY PACK VOLTAGE OUT OF RANGE

PINPOINT TEST D: DTC C1095, HYDRAULIC PUMP MOTOR CIRCUIT FAILURE

PINPOINT TEST E: DTC C 1145 (RF), DTC C1155 (LF), DTC C1165 (RR), DTC C1175 (LR), ANTI-LOCK BRAKE SENSOR CIRCUIT FAILURE

PINPOINT TEST F: DTC C1233 (LF), DTC C1234 (RF), DTC C1235 (RR), DTC C1236 (LR) ANTI-LOCK BRAKE SENSOR INPUT SIGNAL MISSING

PINPOINT TEST G: THE YELLOW ANTI-LOCK BRAKE WARNING INDICATOR DOES NOT SELF-CHECK

PINPOINT TEST H: THE TRACTION CONTROL IS INOPERATIVE

PINPOINT TEST I: THE TRACTION CONTROL CANNOT BE DISABLED

PINPOINT TEST J: THE TRACTION CONTROL SWITCH INDICATOR IS NEVER/ALWAYS ON

PINPOINT TEST A: NO COMMUNICATION WITH THE ANTI-LOCK BRAKE CONTROL MODU

Hydraulic Control Unit (HCU)

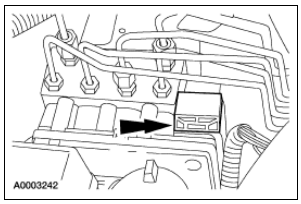
Removal and Installation

⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

⚠ CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

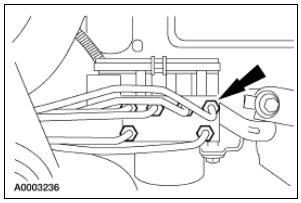
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Disconnect the electrical connector by lifting up on the release tab.

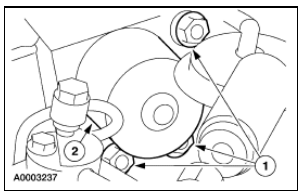


3. **NOTE:** Plug each open port to prevent any brake fluid from spilling.

   Disconnect the brake lines from the hydraulic control unit (HCU).



4. Remove the HCU.
   1. Remove the bolts.
   2. Remove the HCU.



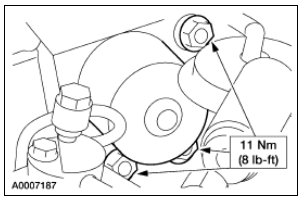
5. **⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.**

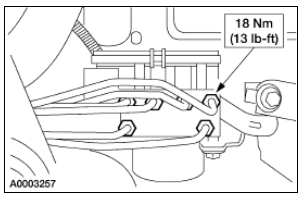
   ⚠ CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

⚠ CAUTION: After the HCU is installed, it is necessary to bleed the hydraulic brake system. For additional information, refer to Section 206-00 .

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

To install, reverse the removal procedure.



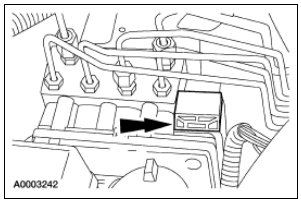


Anti-Lock Brake System (ABS) Module

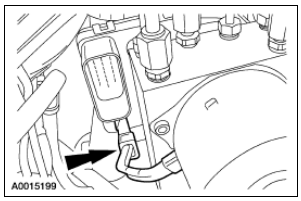
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

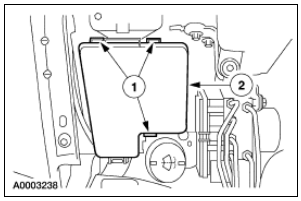
2. Disconnect the anti-lock brake control module electrical connector.



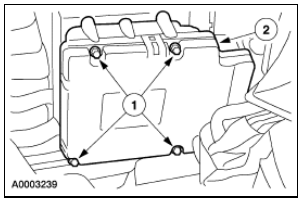
3. Disconnect the anti-lock brake pump motor electrical connector.



4. Position the underhood auxiliary junction box (AJB) aside.
    1. Release the underhood AJB clips.
    2. Position the underhood AJB aside.



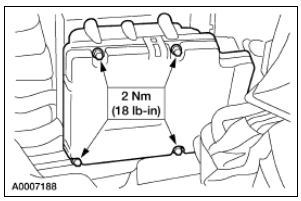
5. Remove the anti-lock brake control module.
    1. Remove the bolts.
    2. Remove the control module.



6. ⚠ **CAUTION: Once the new module is installed, it is necessary to download the module configuration information from the scan tool into the module. For additional information, refer to Section 418-01 .**

   NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

To install, reverse the removal procedure.



Front Wheel Speed Sensor

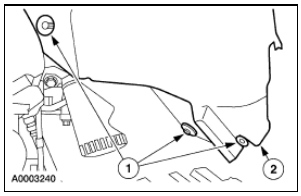
Material

Item	Specification
RTV Silicone Sealant FSTZ-19G204-AB (Canada CXC-114A)	NAVSTR Sealer

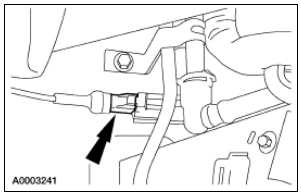
Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

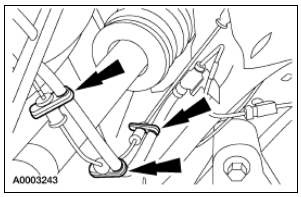
2. Position the inner splash shield aside.
    1. Remove the pin-type retainers.
    2. Position the inner splash shield aside.



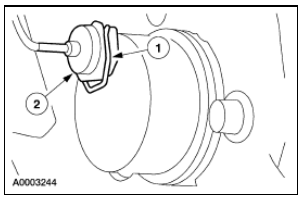
3. Disconnect the anti-lock brake sensor electrical connector.



4. Remove the anti-lock brake sensor harness from the brake hose clips.



5. Remove the anti-lock brake sensor.
    1. Remove the anti-lock brake sensor clip.
    2. Remove the anti-lock brake sensor.



6. **NOTE:** Make sure the anti-lock brake sensor is fully seated before installation of the new clip.

To install, reverse the removal procedure.

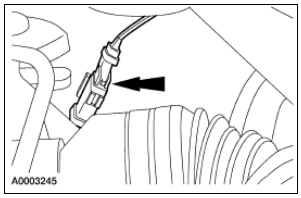
- Apply a 2.5 mm (0.1 in) bead of silicone sealant to the outside diameter of the anti-lock brake sensor.

Rear Wheel Speed Sensor

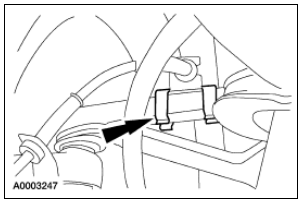
Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Disconnect the rear anti-lock brake sensor electrical connector.



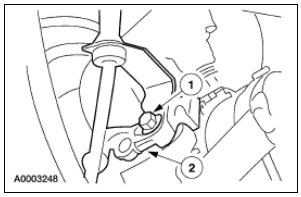
3. Remove the rear anti-lock brake sensor harness from the control arm clips.



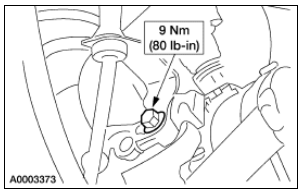
4. **NOTE:** Clean off dirt and foreign material that may have collected around the rear anti-lock brake sensor before removal.

   Remove the rear anti-lock brake sensor.

   1. Remove the anti-lock brake sensor bolt.
   2. Remove the anti-lock brake sensor.



5. To install, reverse the removal procedure.

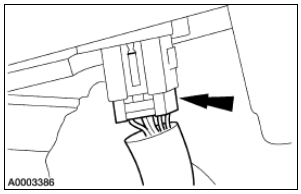


Traction Control Actuator

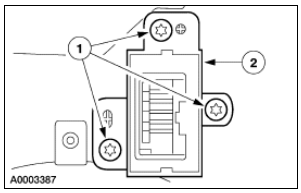
Removal and Installation

1. Remove the console panel assembly. For additional information, refer to Section 501-12 .

2. Remove the traction control switch electrical connector.



3. Remove the traction control switch.
    1. Remove the traction control switch screws.
    2. Remove the traction control switch.



4. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Stability assist module bolts	2		18
Brake line to (HCU) nuts	18	13	
Electronic hydraulic control unit bolts	11	8	
Rear anti-lock brake sensor bolt	9		80
Accelerometer bolts	9		80
Yaw rate sensor bolts	9		80

Anti-Lock Control Traction Control and Stability Assist

The four wheel anti-lock brake system (4WABS) with traction control and stability assist system consists of the following components:

- active brake booster with integral solenoid
- brake booster release switch
- front anti-lock brake sensors
- front anti-lock brake sensor indicators
- hydraulic control unit (HCU)
- stability assist event indicator
- stability assist module
- lateral accelerometer
- rear anti-lock brake sensors
- rear anti-lock brake sensor indicators
- steering wheel position sensor
- two brake pressure transducers
- Advance Trac control switch
- yaw rate sensor
- yellow anti-lock brake warning indicator

For removal and installation of the brake booster release switch, refer to Section 206-07 .

For removal and installation of the front anti-lock brake sensor indicators, refer to Section 204-01 .

For removal and installation of the rear anti-lock brake sensor indicator, refer to Section 205-05 .

For removal and installation of the steering wheel position sensor, refer to Section 211-04 .

Anti-Lock Control Traction Control and Stability Assist

Refer to Wiring Diagrams Cell 42 for schematic and connector information.

Special Tool(s)

 ST1217-A	New Generation STAR (NGS) Tester 418-F048 (007-00500) or equivalent
 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Principles of Operation

The stability assist module executes control of the anti-lock brakes, full speed traction control and stability assist functions to enhance the drivers control of the vehicle. The stability assist manages the interactions between the anti-lock, traction control, and engine control systems to optimize the vehicle traction during deceleration and acceleration. In addition, stability assist function modulates brake pressure during braking and nonbraking conditions as required to counteract excessive vehicle rotation while cornering.

The stability assist module is operational with the ignition switch in the RUN or START positions.

The stability assist module continuously monitors and compares the rotational speed of each wheel. The wheel speeds are measured by the anti-lock brake sensors which electrically sense each tooth of the anti-lock sensor indicator as they pass through the sensors magnetic field. When stability assist detects an impending wheel lock, wheel spin or vehicle motion that is inconsistent with the drivers commands, it modulates brake pressure to the appropriate brake caliper(s). This is accomplished by triggering the hydraulic control unit (HCU) to open and close the appropriate solenoid valves. Once the affected wheel returns to the desired speed, the stability assist module returns the solenoid valves to their normal position, and normal base brake operation resumes.

The stability assist module is self-monitoring. When the ignition switch is turned to the RUN position, the stability assist module will do a preliminary electrical check, and at approximately 20 km/h (12 mph) the pump motor is turned on for approximately one half-second. Any malfunction of the anti-lock brake control system will cause the ABS/TC/Stability Assist to shut off and anti-lock brake warning indicator to illuminate, however the power assist braking system will function normally.

The stability assist module communicates with the powertrain control module (PCM) to assist with traction control. At speeds under 40 km/h (25 mph) the stability assist module requests the PCM to reduce engine torque, while simultaneously applying and releasing the appropriate brake to restore traction when one or both drive wheels lose traction and begin to spin. The PCM accomplishes this by minor incremental timing changes and fewer fuel injector pulses until the stability assist module ends the request (when the driven wheel speed returns to normal). After the vehicle speed exceeds 40 km/h (25 mph), the traction control is accomplished only through the PCM torque control.

An all new stability assist system helps maintain vehicle stability at the limits of tire adhesion. System effectiveness varies with vehicle speed, road conditions, and steering inputs.

The stability assist system constantly monitors vehicle motion relative to the driver's intended course. This is done by using added sensors to compare the steering inputs from the driver with the actual motion of the vehicle.

The driver's steering input is measured from a steering wheel rotation sensor. The motion of the vehicle is determined from a yaw rate sensor (measures rotation about the vehicles vertical axis, caused by steering left/right), a lateral accelerometer (measures the acceleration generated from the vehicle sliding sideways), and the wheel speeds used for anti-lock brake system (ABS) and traction control function. When there is a discrepancy between the driver's inputs and the vehicle motion, the stability assist changes the force at each tire to help control the vehicle. If the vehicle is beginning to rotate excessively left or right, spin out, or slide sideways, the system will attempt to correct the excessive motion. If the vehicle is not responding to steering inputs, the system will attempt to increase the turning response of the vehicle.

The stability assist system defaults to ON when the engine is started. The system does not activate when the vehicle is traveling in reverse. In reverse, ABS and traction control will continue to function as usual. The system uses ABS and traction control (including control of the engine) as well as its more advanced controls to enhance vehicle stability. The stability assist/traction control switch (ATS) allows the driver to control use of the stability assist system. This is independent of the ABS function, which cannot be switched off by the driver. The stability assist system status is indicated by a stability assist warning light in the stability assist/traction control switch. The illuminated stability assist/traction control switch indicates stability assist system is switched off. In vehicles with a message center, the message "ADVANCETRAC OFF" is displayed.

During a stability assist event you may experience any of the following behaviors, which are normal:

· a rumble or grinding sound much like ABS or traction control

· a small deceleration or a reduction in the acceleration of the vehicle

· the stability assist indicator will flash

· if your foot is on the brake pedal, you will feel a vibration in the pedal much like ABS. As with any vehicle equipped with four-wheel anti-lock brakes, do not pump the brakes, but instead, press firmly on the pedal.

· if the event is severe and your foot is not on the brake, the brake pedal will move to apply higher brake forces. A whoosh sound may also be heard from under the instrument panel in an event this severe. All of these behaviors are normal during a stability assist event.

The stability assist system continually monitors and checks all of the sensors and actuators used to improve the stability of the vehicle. Some drivers may notice a slight movement of the brake pedal when the system checks itself. If the brake system has not been bled correctly, the brake pedal movement may become more significant. The brake pedal moves when an active test of the brake booster is run. During this test a small amount of pressure will be generated at the master cylinder, but no pressure will be generated in the calipers. This test will occur above 48 km/h (30 mph) after the vehicle has been running approximately 8 minutes. The test will only be run if the vehicle is stable, the driver is not braking and the accelerator pedal is depressed at least a small amount. If a failure is detected somewhere in the stability assist system which affects either the yaw control or traction control functions, the stability assist indicator will be illuminated. The anti-lock brake function will continue to work as designed unless the yellow anti-lock brake warning indicator is also illuminated. The normal brake function will always occur, unless the red brake warning indicator is illuminated.

Yaw Rate Sensor

The yaw rate sensor measures the rotation rate of the vehicle as it turns left and right.

Lateral Accelerometer

The lateral accelerometer measures the acceleration which corresponds to the force required to slide the vehicle sideways. This acceleration comes in two forms. The first is the centrifugal acceleration which is generated when an object travels around in a circle. The second is the acceleration due to gravity. The accelerometer only measures the acceleration along the lateral (or sideways) direction of the vehicle, so on level ground there is no contribution from this acceleration. However, if the vehicle is parked sideways on a bank or incline, the sensor will measure some lateral acceleration due to gravity even though the vehicle is stationary.

Steering Wheel Rotation Sensor

The steering wheel rotation sensor scans the steering wheel rotation sensor ring in the steering column which has holes punched in it at regular intervals. The steering wheel rotation sensor uses two signal lines to tell the stability assist module whether the steering wheel is being turned left or right and how far it is being turned. The steering wheel rotation sensor does not tell the stability assist module the position of the steering wheel relative to straight ahead. The stability assist system learns this by comparing the steering wheel position with other signals and remembering the position it has learned. The stability assist system confirms this position and modifies it as necessary during every new driving cycle of the vehicle.

Brake Booster

The brake booster is a normal brake booster which has the added function that it can be actuated electrically by the stability assist module. This is sometimes necessary in severe stability assist events, to make sure that the hydraulic control unit can generate enough brake pressure to improve vehicle stability. The help from the brake booster is especially needed in cold weather when the hydraulic control unit cannot draw the brake fluid from the reservoir when it becomes very thick and viscous at cold temperatures. Within the booster is a solenoid for electrical actuation and a release switch to indicate when the driver is stepping on the brake. The solenoid provides electrical actuation of the brake booster. Without the force of the input rod, the air valve is directly opened due to the movement of the energized solenoid. With increasing current applied to the solenoid, the air valve opens and output force is created. With decreasing current applied to the solenoid, the air valve is closed and the vacuum valve opens reducing output force.

The release switch indicates when the brake pedal has been depressed. It is integrated into the booster key that normally sits against the rear shell of the boot in its rest position and it adjoins the valve body when in its balance position. The switch itself provides indication from two positions. In its rest position, it supplies two signals, normally open (NO) and normally closed (NC). Upon application of sufficient force to initiate movement of the key away from the valve body, the brake booster switch changes state, signifying a driver application. When the stability assist module is activating the brake booster, the brake pedal is pulled forward as the valve body moves. The release switch is held in position by the input rod spring and remains against the valve body. Although the brake pedal position (BPP) switch changes state when the brake pedal drops, the release switch remains inactive until such time as it encounters an external force from the driver, whether in a stability assist event controlled by the stability assist module, or in a standard mechanical braking event.

The master cylinder attached to the booster functions the same as on vehicles not equipped with the stability assist system. It differs in that there are two pressure transducers that are installed in spare outlet ports. The values measured by each pressure transducer should be similar. The pressure transducer is a diaphragm type unit. When a pressure is seen the diaphragm is stretched, causing a voltage to be output. As the pressure increases or decreases, the voltage also increases or decreases with it. The configuration of the pressure transducers, which transducer is connected to the primary port and which is connected to the secondary port, is not known by the stability assist module. The harness connectors can be connected to either transducer, therefore, diagnosis of pressure faults requires some care to identify exactly which transducer is failed.

Modules which are normally connected to the BPP switch are connected to a signal from the stability assist module. This signal is called driver brake application. This signal only changes state when the driver has

applied the brake. If the ignition switch is in the RUN position, the brake booster is not electrically actuated, and no failure has been detected, the driver brake application signal will indicate a brake applied when either the BPP switch or the release switch built into the brake booster indicate that the driver has applied the brake pedal. If the ignition switch is in the OFF position, the driver brake application signal will indicate a brake apply only when the BPP switch indicates that the driver is applying the brake pedal. When the ignition switch is in the OFF position, failures cannot be detected. If there are failures, several layers of redundancy will try to keep the driver brake application signal accurate. If the stability assist system detects faults on the driver brake application signal line it will also attempt to maintain correct stoplamp operation by communicating on the standard corporate protocol (SCP) network. Control of the stoplamp operation is also required because the BPP switch can change states during a stability assist event when the driver is not applying the brake pedal. The switch can also change states during the system check of the brake booster. Only the stability assist system can interpret these state changes and determine which ones are actually due to the driver applying the brake. Similarly, the stability assist system can take advantage of its other sensors to detect failures in the BPP switch.

DTC C1963

This Diagnostic Trouble Code (DTC) is stored if the stability assist warning indicator has been turned ON because the system could not confirm the straight ahead position for more than 30 seconds above 18 km/h (11 mph). This condition will most likely occur if there is some other DTC. If there is another DTC logged with this DTC, the repair procedure is to follow the procedure for the other DTC. This DTC can be stored if:

- PRNDL or Reverse switch has failed (check operation of PRNDL display and back-up lights)
- Chassis modifications have been made that were not authorized by Ford.

In very rare circumstances this DTC may be stored by itself without the occurrence of any actual component failure. Two conditions can cause the DTC C1963 to set with no other DTC:

- The steering wheel has been turned while the ignition is off and then the vehicle is started, and either the vehicle is driven continuously in a circle or the vehicle is driven with continuous swerving, sliding or tire spinning.
- A new stability assist module may have been installed in the vehicle and was not calibrated.

Stability Assist Module Calibration

The stability assist module needs to be recalibrated whenever a component specific to the stability assist system is disconnected, moved, or a new component is installed; for additional information regarding the DTCs that require the recalibration procedure, refer to the Stability Assist Calibration List. If a DTC is logged for any component in the stability assist system, the DTC must be cleared before carrying out the recalibration procedure. The need to recalibrate the stability assist module is also indicated by the active/fail lamp flashing. The lamp will flash after the clearing of DTC's that are indicated on the Stability Assist Calibration List. If a DTC is retrieved after recalibration; refer to the Stability Assist Module Diagnostic Trouble Code (DTC) Index. If the active/fail lamp is flashing with no DTC's present, follow the scan tool directions for the stability assist (IVD) module calibration. If installing a new stability assist module, the calibration procedures as well as the configuration procedure must be carried out. For additional information regarding the module configuration procedure, refer to Section 418-01 .

NOTE: After servicing the IVD system and/or components, the Advance Trac System (ATS) light may flash. This indicates that the IVD module needs to be calibrated. With the brake pedal released and the engine running on level ground, select the guided diagnostics icon, chassis braking, IVD then IVD initialization sequence on the WDS. Select each component and then follow the instructions provided.

Using the NGS and the latest version of the service card, select Service Bay Functions, ABS, IVD calibration, 00-02 Lincoln LS and press trigger. Rotate the steering wheel lock-to-lock. When "booster learn" and "swa lock to lock" display is complete, press the trigger. Wait for "Yaw rate init" and "lateral accel sensor" to

display "complete". Press cancel.

Inspection and Verification

NOTE: The stability assist module must be reconfigured upon replacement. For additional information, refer to Section 418-01 .

1. Verify the customer's concern by operating the vehicle to duplicate the condition.
2. Verify the stoplamps operate correctly by depressing and releasing the brake pedal with the ignition switch in the OFF position. If the stoplamps do not operate correctly, refer to Section 417-01 . If the stoplamps operate correctly, proceed to the next step.
3. Verify the PRNDL operates correctly on the instrument cluster. If the PRNDL does not operate correctly, refer to Section 413-01 . If the PRNDL operates correctly, proceed to the next step.
4. Inspect to determine if one of the following mechanical or electrical concerns apply:

Visual Inspection Chart

Mechanical	Electrical
• Anti-lock brake sensor indicator. • HCU. • Incorrectly inflated tires. • Mismatched wheels or tires on vehicle. • Base brake concern. • Brake booster vacuum hose. • Ford specified steering components, suspension components and tire size. • Steering wheel rotation ring.	• Underhood auxiliary junction box (AJB) Fuse: ♦ 114 (30A) ♦ 122 (30A) • Battery junction box (BJB) Fuse: ♦ 405 (10A) • Central junction box (CJB) Fuse: ♦ 203 (5A) ♦ 205 (5A) ♦ 235 (5A) • Stability assist module. • EVAC and fill connector. • Anti-lock brake sensor. • Stability assist/traction control switch. • BPP switch. • Steering wheel rotation sensor. • Brake booster solenoid. • Brake booster release switch. • Primary/main pressure transducer. • Secondary/redundant pressure transducer. • Yaw rate sensor. • Lateral accelerometer. • Wiring harness. • Connectors or connections. • Circuitry.

5. If the concern remains after the inspection, connect the NGS Tester to the data link connector (DLC) located beneath the instrument panel, and select the vehicle to be tested from the NGS Tester menu. If the NGS Tester does not communicate with the vehicle:
   - Check that the program card is correctly installed.
   - Check the connection of the data link connector to the vehicle.
   - Check that the ignition switch is in the RUN position.

6. If the NGS Tester still does not communicate with the vehicle, refer to the New Generation STAR Tester manual.

7. Carry out the DATA LINK DIAGNOSTIC TEST. If NGS Tester responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for stability assist module, go to Pinpoint Test A.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out the self-test diagnostics for the stability assist module.

8. If the DTCs retrieved are related to the concern, go to Stability Assist Module Diagnostic Trouble Code (DTC) Index to continue diagnostics.

9. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.

Stability Assist Module Diagnostic Trouble Code (DTC) Index

NOTE: The need to recalibrate the stability assist module is indicated by the active/fail lamp flashing. There are other service actions that may require recalibration where there is no flashing lamp. Refer to the Stability Assist Calibration List. The lamp will flash after the clearing of DTC's that are indicated on the stability assist calibration list.

NOTE: Stability assist may be referred to as interactive vehicle dynamics (IVD) in the NGS Tester.

Stability Assist Module Diagnostic Trouble Code (DTC) Index
NOTE: DTC C1730 (Reference Voltage Out Of Range) must be repaired before DTC C1279, C1280, C1281, C1282, C1288, C1289.

DTCDescriptionSourceActionB1255Air Temperature External Sensor Circuit OpenDATCREFER to Section 412-00 .B1257Air Temperature External Sensor Circuit Short to GroundDATCREFER to Section 412-00 .B1342ECU Is DefectiveStability AssistCLEAR the DTCs. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new stability assist module. REFER to Anti-Lock Brake System (ABS) Module Stability Assist . REPEAT the self-test.B1485Brake Pedal Input Circuit Battery ShortStability AssistGO to Pinpoint Test B .B1676Battery Pack Voltage Out of RangeStability AssistGO to Pinpoint Test C .B2477Module Configuration FailureStability AssistREFER to Section 418-01 .C1095ABS Hydraulic Pump Motor Circuit FailureStability AssistGO to Pinpoint Test D .C1145Speed Wheel Sensor RF Input Circuit FailureStability AssistGO to Pinpoint Test E .C1155Speed Wheel Sensor LF Input Circuit FailureStability AssistGO to Pinpoint Test E .C1165Speed Wheel Sensor RR Input Circuit FailureStability AssistGO to Pinpoint Test E .C1175Speed Wheel Sensor LR Input Circuit FailureStability AssistGO to Pinpoint Test E .C1233Speed Wheel LF Input Signal MissingStability AssistGO to Pinpoint Test F .C1234Speed Wheel RF Input Signal MissingStability AssistGO to Pinpoint Test F .C1235Speed Wheel RR Input Signal

MissingStability AssistGO to Pinpoint Test F .C1236Speed Wheel LR Input Signal MissingStability AssistGO to Pinpoint Test F .C1277Steering Wheel Angle 1 and 2 Circuit FailureStability AssistGO to Pinpoint Test G .C1278Steering Wheel Angle 1 and 2 Signal FaultedStability AssistGO to Pinpoint Test G .C1279Yaw Rate Sensor Circuit FailureStability AssistGO to Pinpoint Test H .C1280Yaw Rate Sensor Signal FaultStability AssistGO to Pinpoint Test H .C1281Lateral Accelerometer Circuit FailureStability AssistGO to Pinpoint Test I .C1282Lateral Accelerometer Signal FaultStability AssistGO to Pinpoint Test I .C1285Booster Solenoid Circuit FailureStability AssistGO to Pinpoint Test J .C1286Booster Mechanical FailureStability AssistGO to Pinpoint Test K .C1287Booster Pedal Force Switch Circuit FailureStability AssistGO to Pinpoint Test L .C1288 [a]Pressure Transducer Main/Primary Input Circuit FailureStability AssistGO to Pinpoint Test M .C1289 [a]Pressure Transducer Redundant/Secondary Input Circuit FailureStability AssistGO to Pinpoint Test N .C1730Reference Voltage Out of Range (+5 V)Stability AssistGO to Pinpoint Test O .C1805Mismatched PCM and/or stability assist moduleStability AssistCheck for correct component and configuration for the PCM and stability assist module. INSTALL new as necessary. REFER to Anti-Lock Brake System (ABS) Module Stability Assist or Section 303-14 as necessary. CLEAR the DTC. REPEAT the self-test.C1960Driver Brake Apply Circuit FaultStability AssistGO to Pinpoint Test P .C1963Stability Control Inhibit WarningStability AssistFor additional information about how DTC C1963 can be set, GO to the Principles of Operation. CLEAR the DTC. REPEAT the self-test. If DTC C1963 is still present, RECALIBRATE the stability assist module. REFER to Section 418-01 .C1969TC/YC Switch Lamp Circuit FaultStability AssistGO to Pinpoint Test S .P0112IAT Circuit Low InputPCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.P0117ECT Circuit Low InputPCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.P0118ECT Circuit High InputPCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.P0122TP Sensor A Circuit Low InputPCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.P0123TP Sensor A Circuit High InputPCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.P0500Vehicle Speed Sensor MalfunctionPCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.P0501Vehicle Speed Sensor Range/PerformancePCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.P0502Vehicle Speed Sensor Low InputPCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.P0503Vehicle Speed Sensor IntermittentPCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.P0707Transmission Range Sensor Circuit Low InputPCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.P0708Transmission Range Sensor Circuit High InputPCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.P1120TP Sensor Out Of Range Low (Ratch Too Low)PCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.P1183Engine Oil Temperature Circuit MalfunctionPCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.P1184Engine Oil Temperature Out of Self-Test RangePCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.U1009SCP (J1850) Invalid or Missing Data for Engine TorquePCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.U1027SCP (J1850) Invalid or Missing Data for Engine RPMPCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.U1059SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/PRNDLPCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.U1073SCP (J1850) Invalid or Missing Data for Engine CoolantPCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.U1243SCP (J1850) Invalid or Missing Data for Exterior EnvironmentPCMREFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.U1262SCP (J1850) Communication Bus FaultNetwork FaultREFER to Section 418-00 .

[a] Note: If DTC C1288 and C1289 are present with a low or spongy brake pedal feel, manually bleed the hydraulic brake system to remove any air in the system. Once the brake pedal is firm, turn the ignition key to the run position, clear the DTCs and firmly apply and release the brake pedal. If the Advance Trac® lamp continues flashing, calibrate the system. Refer to Calibration procedure in this section. Again firmly apply the brake pedal while observing the Advance Trac® warning lamp. If the condition does not return, test-drive the vehicle to verify the repair. Follow this procedure only if DTC C1288 and C1289 are present and the brake pedal has a low or spongy feel. Otherwise, refer to the Stability Assist Module Diagnostic Trouble Code (DTC) Index.

Stability Assist Module Parameter Identification (PID) Index

Stability Assist Module Parameter Identification (PID) Index

PID	Description	Expected Value
ABSLF_I	Left Front ABS Inlet Valve	Off---, On---
ABSLF_O	Left Front ABS Outlet Valve	Off---, On---
ABSLR_I	Rear or Left Rear ABS Inlet Valve	Off---, On---
ABSLR_O	Left Rear ABS Outlet Valve	Off---, On---
ABSRF_I	Right Front ABS Inlet Valve	Off---, On---
ABSRF_O	Right Front ABS Outlet Valve	Off---, On---
ABSRR_I	Right Rear ABS Inlet Valve	Off---, On---
ABSRR_O	Right Rear ABS Outlet Valve	Off---, On---
BLNMDSC	Booster Learn Cycle Successful	No, Yes
BMECFAL	Booster Mechanical Failure	No, Yes
BOO	Brake Switch Input	Off, On
BSABNCR	Booster Solenoid Abnormal Current	No, Yes
BSBOOFL	Booster Solenoid Brake Switch Failure	No, Yes
BSCIRFL	Booster Solenoid Circuit Failure	No, Yes
BSNCFL	Booster Solenoid Output Normally Closed Switch Failure (Brake Booster Pedal Force)	No, Yes
BSNOFL	Booster Solenoid Output Normally Open Switch Failure (Brake Booster Pedal Force)	No, Yes
BSTSOST	Booster Solenoid Output State	No, Yes
CCNT	Number of Continuous DTCs in Module	one count per bit
DUMP_PT	Booster Non-Volatile Memory Dump Rise Point	#####
FAILCNT	Booster Non-Volatile Memory Failure Count	#####
LAT_ACC	Lateral Acceleration Value	#####
LF_WSPD	Left Front Wheel Speed Sensor	one count per bit
LR_WSPD	Left Rear Wheel Speed Sensor	one count per bit
MPRETDR	Main Brake Pressure Transducer	#####
MPRTDRF	Main Brake Pressure Transducer Failure	No, Yes
PDFCENO	Brake Booster Pedal Force Switch Normally Open (State)	Closed, Open
PDFCENC	Brake Booster Pedal Force Switch Normally Closed (State)	Closed, Open
PRMLPRE	Low Pressure Feedback Primary State	ACTIVE, notACT
RF_WSPD	Right Front Wheel Speed Sensor	one count per bit
RISE_PT	Booster Non-Volatile Memory Rise Point	#####
RISECHG	Booster Non-Volatile Memory Change In Rise Point	#####

RPRETDR	Redundant Brake Pressure Transducer	#####
RR_WSPD	Right Rear Wheel Speed Sensor	one count per bit
SECLPRE	Low Pressure Feedback Secondary State	ACTIVE, notACT
SENVBAT	stability assist Sensor Supply Voltage	#####
SGOTSTA	Switch Test Signal Output State	No, Yes
SPRTDRF	Redundant Brake Pressure Transducer Failure	No, Yes
SWA_POS	Steering Wheel Angle	#####
SWA_CCW	CCW Steering Wheel Angle Position From Start	#####
SWA_CW	CW Steering Wheel Angle Position From Start	#####
SWA1	Steering Wheel Angle # 1	Off---, OffO--, Off-B-, Off--G, OffO-G, OffOB-, Off-BG, OffOBG, On---, OnO--, On-B-, On--G, OnO-G, OnOB-, On-BG, OnOBG
SWA2	Steering Wheel Angle # 2	Off---, OffO--, Off-B-, Off--G, OffO-G, OffOB-, Off-BG, OffOBG, On---, OnO--, On-B-, On--G, OnO-G, OnOB-, On-BG, OnOBG
TC_LVAL	Left T/A Control Valve Output Status	Off---, On---
TC_RVAL	Right T/A Control Valve Output Status	Off---, On---
TC/YC_SW	TC or TC/YC (Stability Assist) Switch, Push Button Input Status	Off, On
TC/YC_FNC	TC or TC/YC (Stability Assist) Function Status	Off, On
YAW_IN	Yaw Rate Sensor Input	Off---, Off-B-, Off--G, On---, On-B-, On--G
YAWRATE	Yaw Rate Value	#####
YAWOUT or LAT_IN	Lateral Accelerometer Input	Off---, Off-B-, Off--G, On---, On-B-, On--G

Stability Assist Module Active Command Index

Stability Assist Module Active Command Index

Active Command	Display	Action
ABS OUTPUT CONTROL	LF INLET	Off, On
	LF OUTLET	Off, On
	LR INLET	Off, On
	LR OUTLET	Off, On
	PMP MOTOR	Off, On
	R INLET (Low Pressure Feed Valve)	Off, On
	R OUTLET (Low Pressure Feed Valve)	Off, On
	RF INLET	Off, On
	RF OUTLET	Off, On
	RR INLET	Off, On
	RR OUTLET	Off, On

TRACTION CONTROL	LR TC VLV	Off, On
	RR TC VLV	Off, On
YAW OUTPUT CONTROL COMMAND	BOOST SOL	Off, On
	PRI LP VLV	Off, On
	SEC LP VLV	Off, On
	LAT INIT	Off, On
	YAW INIT	Off, On
	SW TST SG	Off, On

Stability Assist Calibration List

NOTE: The need to recalibrate the stability assist module is indicated by the active/fail lamp flashing. Refer to Section 418-01 for other service actions requiring recalibration. The lamp will flash after the clearing of DTC's that are indicated on the stability assist calibration list.

Stability Assist Calibration List

DTC	Description	Stability Assist Calibration
C1277	Steering Wheel Angle 1 and 2 Circuit Failure	YES
C1278	Steering Wheel Angle 1 and 2 Signal Faulted	YES
C1279	Yaw Rate Sensor Circuit Failure	YES
C1280	Yaw Rate Sensor Signal Fault	YES
C1281	Lateral Accelerometer Circuit Failure	YES
C1282	Lateral Accelerometer Signal Fault	YES
C1283	Switch Test Signal Failure	YES
C1285	Booster Solenoid Circuit Failure	YES
C1286	Booster Mechanical Failure	YES
C1287	Booster Pedal Force Switch Circuit Failure	YES
C1288	Pressure Transducer Main / Primary Input Circuit Failure	YES
C1289	Pressure Transducer Redundant / Secondary Input Circuit Failure	YES
C1730	Reference Voltage Out of Range (+5 V)	YES
C1960	Driver Brake Apply Circuit Fault	NO
C1963	Stability Control Inhibit Warning	NO

Symptom Chart

NOTE: Refer to the wiring diagrams for connector numbers stated in the pinpoint tests.

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE STABILITY ASSIST MODULE

PINPOINT TEST B: DTC B1485 BRAKE PEDAL INPUT CIRCUIT BATTERY SHORT

PINPOINT TEST C: DTC B1676 BATTERY PACK VOLTAGE OUT OF RANGE

PINPOINT TEST D: DTC C1095 ABS HYDRAULIC PUMP MOTOR CIRCUIT FAILURE

PINPOINT TEST E: DTC C1145 (RF), DTC C1155 (LF), DTC C1165 (RR), DTC C1175 (LR) ANTI-LOCK BRAKE SENSOR INPUT CIRCUIT FAILURE

PINPOINT TEST F: DTC C1233 (LF), DTC C1234 (RF), DTC C1235 (RR), DTC C1236 (LR) ANTI-LOCK BRAKE SENSOR INPUT SIGNAL MISSING

PINPOINT TEST G: DTC C1277 STEERING WHEEL ANGLE 1 AND 2 CIRCUIT FAILURE, DTC C1278 STEERING WHEEL ANGLE 1 AND 2 CIRCUIT FAULTED

PINPOINT TEST H: DTC C1279 YAW RATE SENSOR CIRCUIT FAILURE, DTC C1280 YAW RATE SENSOR SIGNAL FAULT

PINPOINT TEST I: DTC C1281 LATERAL ACCELEROMETER CIRCUIT FAILURE, DTC C1282 LATERAL ACCELEROMETER SIGNAL FAULT

PINPOINT TEST J: DTC C1285 BRAKE BOOSTER SOLENOID OUTPUT FAILURE

PINPOINT TEST K: DTC C1286 BOOSTER MECHANICAL FAILURE

PINPOINT TEST L: DTC C1287 BOOSTER PEDAL FORCE SWITCH CIRCUIT FAILURE

PINPOINT TEST M: DTC C1288 PRESSURE TRANSDUCER MAIN/PRIMARY INPUT CIRCUIT FAILURE

PINPOINT TEST N: DTC C1289 PRESSURE TRANSDUCER REDUNDANT/SECONDARY INPUT CIRCUIT FAILURE

PINPOINT TEST O: DTC C1730 REFERENCE VOLTAGE OUT OF RANGE (+5 V)

PINPOINT TEST P: DTC C1960 DRIVER BRAKE APPLY CIRCUIT FAULT

PINPOINT TEST Q: THE YELLOW ABS WARNING INDICATOR DOES NOT SELF-CHECK

PINPOINT TEST R: THE TRACTION CONTROL IS INOPERATIVE

PINPOINT TEST S: THE STABILITY ASSIST/TRACTION CONTROL SWITCH INDICATOR IS NEVER/ALWAYS ON

PINPOINT TEST T: THE STABILITY ASSIST SYSTEM CANNOT BE DISABLED

PINPOINT TEST U: THE STABILITY ASSIST INDICATOR DOES NOT SELF-CHECK

Hydraulic Control Unit (HCU)

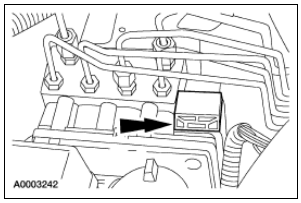
Removal and Installation

⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

⚠ CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

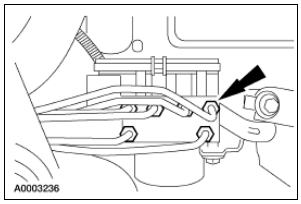
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Disconnect the electrical connector by lifting up on the release tab.

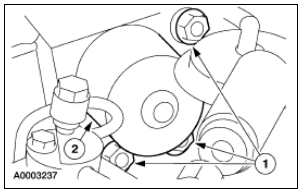


3. **NOTE:** Plug each open port to prevent any brake fluid from spilling.

   Disconnect the brake lines from the hydraulic control unit (HCU).



4. Remove the HCU.
   1. Remove the bolts.
   2. Remove the HCU.



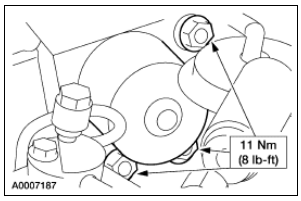
5. **⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.**

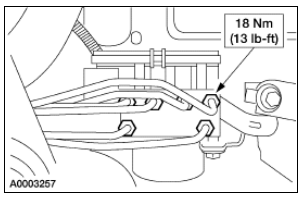
   ⚠ CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled onto a painted or plastic surface, immediately wash it with water.

⚠ CAUTION: After the HCU is installed, it is necessary to bleed the hydraulic brake system. For additional information, refer to Section 206-00 .

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

To install, reverse the removal procedure.





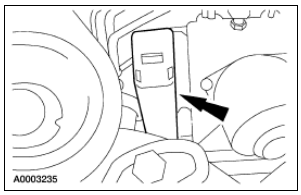
Anti-Lock Brake System (ABS) Module Stability Assist

Removal

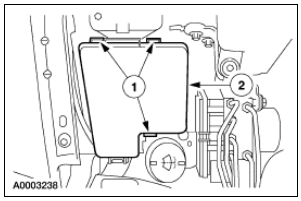
⚠ CAUTION: Before the module is removed, it is necessary to upload the module configuration information to the New Generation STAR (NGS) tester. For additional information, refer to Section 418-01 .

1. Disconnect the battery ground cable.

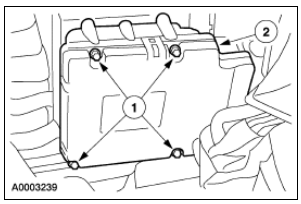
2. Disconnect the anti-lock brake control module electrical connector by lifting up on the release tab.



3. Position aside the underhood auxiliary junction box (AJB).
    1. Release the underhood AJB clips.
    2. Position the underhood AJB aside.



4. Remove the stability assist control module.
    1. Remove the bolts.
    2. Remove the control module.

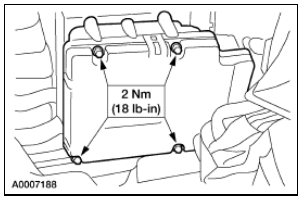


Installation

⚠ CAUTION: Once the new module is installed, it is necessary to download the module configuration information from the New Generation STAR (NGS) Tester into the module. For additional information, refer to Section 418-01 .

NOTE: When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 mi) or more to relearn the strategy.

1. To install, reverse the removal procedure.


2 Nm
(18 lb-in)
A0007188

Front Wheel Speed Sensor

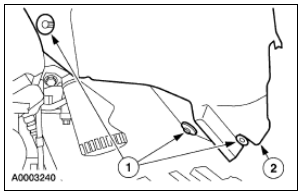
Material

Item	Specification
RTV Silicone Sealant FSTZ-19G204-AB (Canada CXC-114A)	NAVSTR Sealer

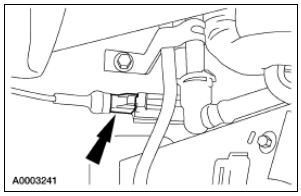
Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

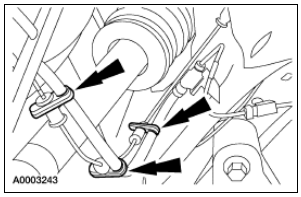
2. Position the inner splash shield aside.
    1. Remove the pin-type retainers.
    2. Position the inner splash shield aside.



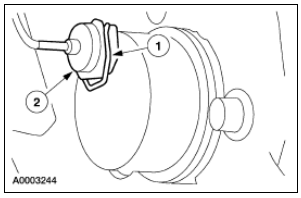
3. Disconnect the anti-lock brake sensor electrical connector.



4. Remove the anti-lock brake sensor harness from the brake hose clips.



5. Remove the anti-lock brake sensor.
    1. Remove the anti-lock brake sensor clip.
    2. Remove the anti-lock brake sensor.



6. **NOTE:** Make sure the anti-lock brake sensor is fully seated before installation of the new clip.

To install, reverse the removal procedure.

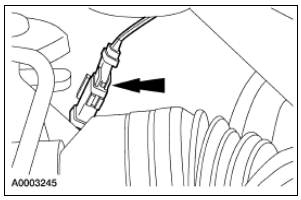
- Apply a 2.5 mm (0.1 in) bead of silicone sealant to the outside diameter of the anti-lock brake sensor.

Rear Wheel Speed Sensor

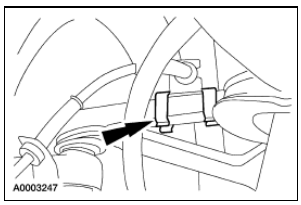
Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Disconnect the rear anti-lock brake sensor electrical connector.



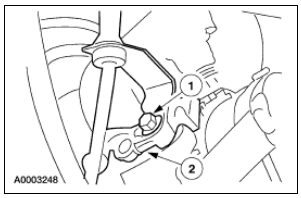
3. Remove the rear anti-lock brake sensor harness from the control arm clips.



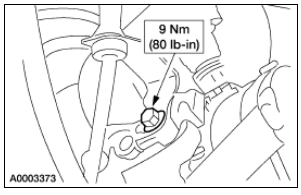
4. **NOTE:** Clean off dirt and foreign material that may have collected around the rear anti-lock brake sensor before removal.

   Remove the rear anti-lock brake sensor.

   1. Remove the anti-lock brake sensor bolt.
   2. Remove the anti-lock brake sensor.



5. To install, reverse the removal procedure.



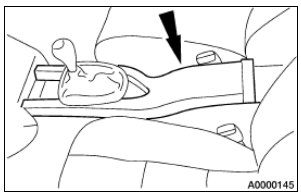
Yaw Rate Sensor

Removal

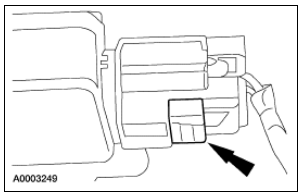
NOTE: The stability assist module needs to be recalibrated whenever a component is disconnected, moved, or a new component is installed. For additional information regarding the recalibration procedure and when the recalibration procedure should be carried out, refer to Principles of Operation. For additional information regarding the module configuration procedure, refer to Section 418-01 .

1. Remove the floor console. For additional information, refer to Section 501-12 .

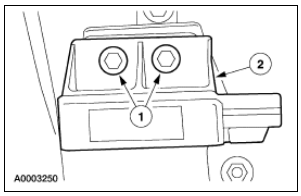
2. Remove the center A/C duct.



3. Disconnect the yaw rate sensor electrical connector.



4. Remove the yaw rate sensor.
    1. Remove the yaw rate sensor bolts.
    2. Remove the yaw rate sensor.

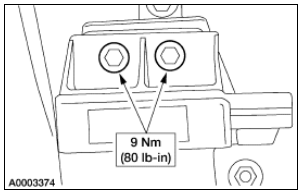


Installation

NOTE: The stability assist module needs to be recalibrated whenever a component is disconnected, moved, or a new component is installed. For additional information regarding the recalibration procedure and when the recalibration procedure should be carried out, refer to Principles of Operation. For additional information regarding the module configuration procedure, refer to Section 418-01 .

NOTE: The yaw rate sensor is positioned with the connector pointed to the left side of the vehicle. Be sure to mount the sensor in this orientation during the installation procedure.

1. To install, reverse the removal procedure.

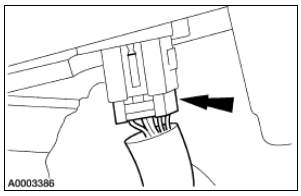

9 Nm
(80 lb-in)
A0003374

Traction Control Actuator Advance Trac

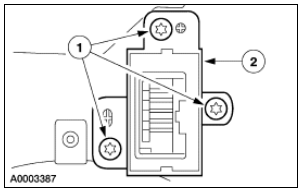
Removal

1. Remove the floor console finish panel. For additional information, refer to Section 501-12 .

2. Disconnect the Advance Trac control switch electrical connector.



3. Remove the Advance Trac control switch.
    1. Remove the Advance Trac control switch screws.
    2. Remove the Advance Trac control switch.



Installation

1. To install, reverse the removal procedure.

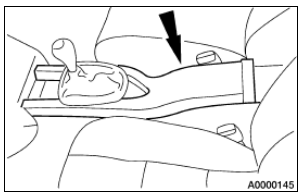
Accelerometer

Removal

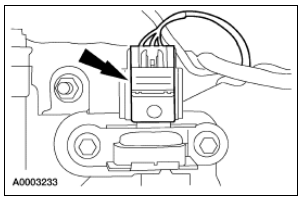
NOTE: The stability assist module needs to be recalibrated whenever a component is disconnected, moved, or a new component is installed. For additional information regarding the recalibration procedure and when the recalibration procedure should be carried out, refer to Principles of Operation. For additional information regarding the module configuration procedure, refer to Section 418-01 .

1. Remove the floor console. For additional information, refer to Section 501-12 .

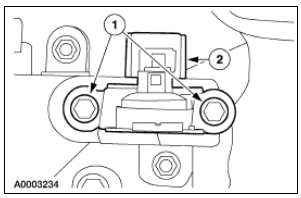
2. Remove the console A/C duct.



3. Disconnect the lateral accelerometer electrical connector.



4. Remove the lateral accelerometer.
    1. Remove the lateral accelerometer bolts.
    2. Remove the lateral accelerometer.

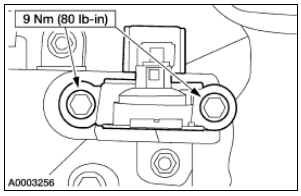


Installation

NOTE: The stability assist module needs to be recalibrated whenever a component is disconnected, moved, or a new component is installed. For additional information regarding the recalibration procedure and when the recalibration procedure should be carried out, refer to Principles of Operation. For additional information regarding the module configuration procedure, refer to Section 418-01 .

NOTE: The accelerometer is positioned with the connector pointed to the left side of the vehicle. Be sure to mount the accelerometer in this orientation during the installation procedure.

1. To install, reverse the removal procedure.

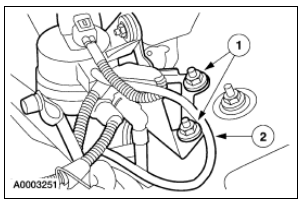

9 Nm (80 lb-in)
A0003256

Transducer Primary

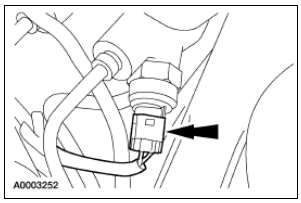
Removal

NOTE: The stability assist module needs to be recalibrated whenever a component is disconnected, moved, or a new component is installed. For additional information regarding the recalibration procedure and when the recalibration procedure should be carried out, refer to Principles of Operation. For additional information regarding the module configuration procedure, refer to Section 418-01 .

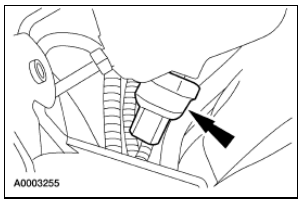
1. Position the vapor management valve aside.
    1. Remove the vapor management valve bracket bolts.
    2. Position the vapor management valve aside.



2. Disconnect the main pressure transducer electrical connector.



3. Remove the main pressure transducer.



Installation

NOTE: The stability assist module needs to be recalibrated whenever a component is disconnected, moved, or a new component is installed. For additional information regarding the recalibration procedure and when the recalibration procedure should be carried out, refer to Principles of Operation. For additional information regarding the module configuration procedure, refer to Section 418-01 .

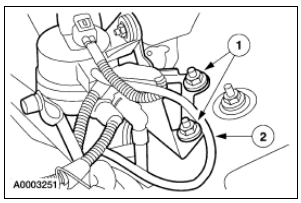
1. To install, reverse the removal procedure.

Transducer Secondary

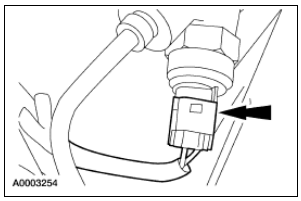
Removal

NOTE: The stability assist module needs to be recalibrated whenever a component is disconnected, moved, or a new component is installed. For additional information regarding the recalibration procedure and when the recalibration procedure should be carried out, refer to Principles of Operation. For additional information regarding the module configuration procedure, refer to Section 418-01 .

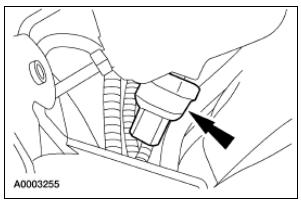
1. Position the vapor management valve aside.
    1. Remove the vapor management valve bracket bolts.
    2. Position the vapor management valve aside.



2. Disconnect the redundant pressure transducer electrical connector.



3. Remove the redundant pressure transducer.



Installation

NOTE: The stability assist module needs to be recalibrated whenever a component is disconnected, moved, or a new component is installed. For additional information regarding the recalibration procedure and when the recalibration procedure should be carried out, refer to Principles of Operation. For additional information regarding the module configuration procedure, refer to Section 418-01 .

1. To install, reverse the removal procedure.

Fluid Maintenance

⚠ CAUTION:Use only MERCON® V transmission fluid. Use of any other fluids can result in transmission failure.

Intervals Normal maintenanceNot necessary. Filled for life.Severe duty maintenanceChange the fluid at 48,000 km (30,000 miles) intervals. Use MERCON ® V.

General Specifications

Vehicle	Engine	Approximate Liters	Refill Capacity [1] U.S. Quarts	Fluid Type
Lincoln LS 5R55N	3.0L, 3.9L	11.2	11.9	MERCON ® V XT-5-QM

[1] Approximate dry capacity, includes cooler and tubes. Fluid level procedures in this section should be used to determine actual fluid requirements and fluid specification. DO NOT OVERFILL. If it is necessary to add or change fluid, use only fluid that has been certified by the supplier as meeting the Ford Motor Company specification shown.

General Specifications

Item	Specification
Fluid	
Motorcraft MERCON ® V Automatic Transmission Fluid XT-5-QM	MERCON ® V
Fluid Filter	
Inline Transmission Fluid Filter Kit	XC3Z-7B155-AA
Inline Transmission Fluid Filter	XC3Z-7B155-BA
Lubricant	
Ford Multi-Purpose Grease D0AZ-19584-AA	ESB-M1C93-B
Premium Long Life Grease XG-1-C	ESA-M1C75-B
Sealant	
Threadlock 262 E2FZ-19554-B	WSK-M2G351-A6

Torque Specifications

Description	Nm	lb-ft	lb-in
Case-to-center support screw	11	8	
Converter drain plug	10		89
Digital transmission range (TR) sensor-to-case screws	10		89
Driveshaft bolts and nuts	81	60	
Extension housing screws and studs	26	19	

Fill plug to extension housing	20	15	
Fluid level indicator plug-to-drain pipe assembly	10		89
Fluid pan drain plug	26	19	
Fluid pump housing screws	25	18	
Heat shield screws	10		89
Locknut for band adjustment	54	40	
Main control-to-case bolts	10		89
Manual control valve detent spring-to-case bolt	10		89
Manual control lever shaft nut	48	35	
Output shaft-to-flange nut	131	97	
Overdrive band adjustment screw	14	10	
Pressure tap plug to case	13	10	
Pump assembly-to-case screws	24	18	
Reverse servo assembly-to-case bolts	10		89
Separator to main control bolts	10		89
Shift cable bracket bolts	25	18	
Solenoid body-to-case bolts	8		71
Speed sensor-to-case screws	10		89
Torque converter adapter plate nuts to converter	44	33	
Torque converter adapter plate-to-flexplate nut	38	28	
Transmission cooler fitting to case	47	35	
Transmission cooler line bracket nut (V6 application)	10		89
Transmission cooler line bracket nut (V8 application)	18	13	
Transmission cooler tube nut to case fitting	40	30	
Transmission fluid filter-to-case bolts	10		89
Transmission fluid pan-to-case screws	11	8	
Transmission mount-to-extension housing center screw	40	30	
Transmission mount-to-extension housing screws	50	37	
Transmission mount-to-floor pan bolts	55	41	
Transmission-to-engine bolts	47	35	
Vehicle harness-to-solenoid body screw	5		44

End Play Specifications

Transmission Overdrive End Play Dimension D	**Select Thrust Washer (No. 1 Nylon)**		**Identification: Color**
	Part Number	**Thickness**	
38.04-38.28 mm (1.50-1.51 in)	XW4Z-XA	1.70-1.75 mm (0.06 in)	Brown/8
38.29-38.43 mm (1.51 in)	XW4Z-NA	1.85-1.90 mm (0.07 in)	Red/4
38.44-38.63 mm (1.51-1.52 in)	XW4Z-RA	2.05-2.10 mm (0.08 in)	Black/6
38.64-38.78 mm (1.52-1.53 in)	XW4Z-YA	2.20-2.25 mm (0.09 in)	Orange/9
38.79-38.97 mm (1.53 in)	XW4Z-ZA	2.40-2.45 mm (0.10 in)	Purple/10

End Play Specifications

Rear (No. 4) Dimension E	Selective Needle Bearings (No. 4)		Identification: Notches
	Part Number	Thickness	
1.67-1.85 mm (0.066-0.073 in)	XW4Z-7D014-CA	2.65-2.80 mm (0.104-0.110 in)	0
1.86-2.04 mm (0.073-0.080 in)	XW4Z-7D014-DA	2.80-2.95 mm (0.110-0.116 in)	1
2.05-2.23 mm (0.081-0.088 in)	XW4Z-7D014-EA	3.00-3.15 mm (0.118-0.124 in)	2
2.25-2.43 mm (0.089-0.096 in)	XW4Z-7D014-FA	3.20-3.35 mm (0.126-0.132 in)	3

Torque Converter End Play

Transmission Model	Converter End Play			
	New or Rebuilt Converter		Used Converter	
	mm	inch	mm	inch
5R55N	0.44 max.	0.017 max.	0.80 max.	0.031 max.

Band Adjustment And Torque Chart

Description	Number of Turns to Back Off	Locknut		Adjusting Screw	
		Nm	Lb-Ft	Nm	Lb-Ft
Intermediate Band	2.0	54	40	14	10
Overdrive Band	2.0	54	40	14	10

Selective Snap Rings

Coast and Direct Clutch Drum					Forward Clutch Cylinder				
Part Number	Thickness		Diameter		Part Number	Thickness		Diameter	
	mm	inch	mm	inch		mm	inch	mm	inch
E860126-S	1.37	0.0539	130.1	5.122					
E860127-S	1.73	0.0681	130.1	5.122	XW4Z-7D483-AB	1.73	0.0681	141.45	5.56
E860128-S	2.08	0.0819	130.1	5.122	XW4Z-7D483-AC	2.08	0.0819	141.45	5.56
E860129-S	2.44	0.0961	130.1	5.122	XW4Z-7D483-AD	2.44	0.0961	141.45	5.56

Service Identification Model Chart

Vehicle Application			
7000 Prefix and Suffix	C=Column F=Floor	Engine Displacement	Vehicle Application
1W4P-BA, RJL-M	F	3.0L	Lincoln LS

1W4P-AA, RJL-L	F	3.9L	Lincoln LS

Solenoid Operation Chart

Base Gearshift Selector Position	Powertrain Control Module (PCM) Commanded Gear	5R55N Solenoid States						
		SSA	SSB	SSC	SSD	PCA	PCB	PCC
P/N	P	On	Off	Off	On	L [1]	C [2]	L
R	R	On	Off	Off	On	L	H [3]	H
D5	1	On	Off	Off	On	C	L	L
	2	On	Off	On	On	L	C	L
	3	On	On	Off	On	C	L	L
	4	Off	Off	Off	On	C	L	H
	5	Off	Off	On	On	C	C	H
D4	1	On	Off	Off	On	C	L	L
	2	On	Off	On	On	L	C	L
	3	On	On	Off	ON	C	L	L
	4	Off	Off	Off	Off	C	C	H
3	3	On	On	Off	Off	C	C	L
2	2	On	Off	On	Off	C	C	L
1	1	On	Off	Off	Off	C	C	L

[1] Low line pressure
[2] Control line pressure
[3] High line pressure

Solenoid Operation Chart

Select Shift Gearshift Selector Position	Powertrain Control Module (PCM) Commanded Gear	5R55N Solenoid States						
		SSA	SSB	SSC	SSD	PCA	PCB	PCC
P/N	P	On	Off	Off	On	L [1]	C [2]	L
R	R	On	Off	Off	On	L	H [3]	H
D5	1	On	Off	Off	On	C	L	L
	2	On	Off	On	On	L	C	L
	3	On	On	Off	On	C	L	L
	4	Off	Off	Off	On	C	L	H
	5	Off	Off	On	On	C	C	H
D4	1	On	Off	Off	On	C	L	L
	2	On	Off	On	On	L	C	L
	3	On	On	Off	On	C	L	L
	4	Off	Off	Off	Off	C	C	H
+/-	1	On	Off	Off	Off	H	H	L
	2	On	Off	On	Off	H	H	L
	3	On	On	Off	Off	H	H	L
	4	Off	Off	Off	Off	H	H	H

	5	Off	Off	On	On	H	H	H

[1] Low line pressure
[2] Control line pressure
[3] High line pressure

Band/Clutch Application Chart A

	Overdrive Band	Intermediate Band	Reverse Band	Intermediate Clutch	Forward Clutch	Direct Clutch	Coast Clutch
PARK							
REVERSE			A [3]	A [3]		A [3]	
NEUTRAL							
1st					A [3]		
2nd	A [3]				A [3]		
3rd		Ac [2]		A [3]	A [3]		
4th				ANE [1]	A [3]	A [3]	
5th	A [3]				ANE [1]	A [3]	A [3]
1st [a]			Ac [2]		A [3]		Ac [2]
2nd [a]	A [3]		Ac [2]		A [3]		Ac [2]
3rd [a]		Ac [2]		A [3]	A [3]		Ac [2]
4th [a]				ANE [1]	A [3]	A [3]	Ac [2]
MAN. 3rd		Ac [2]		A [3]	A [3]		Ac [2]
MAN. 2nd	A [3]		Ac [2]		A [3]		
MAN. 1st			Ac [2]		A [3]		Ac [2]

[3] A = Applied
[1] ANE = Applied but no effect
[a] D4 Position (overdrive canceled)
[2] Ac = Applied to carry coast torque

Band/Clutch Application Chart B

	Direct One-Way Clutch		Low One-Way Clutch		Intermediate One-Way Clutch		Engine Braking
	Drive	Coast	Drive	Coast	Drive	Coast	
PARK							
REVERSE	H [5]	OR [6]	NE		ORI [7]		YES
NEUTRAL							
1st	H [5]	OR [6]	H [5]	OR [6]	NE [4]		NO
2nd	OR [6]	OR [6]	H [5]	OR [6]	NE [4]		NO
3rd	H [5]	OR [6]	OR [6]	OR [6]	H [5]	OR [6]	NO
4th	H [5]	OR [6]	OR [6]	OR [6]	OR [6]	OR [6]	NO
5th	OR [6]	OR [6]	OR [6]	OR [6]	OR [6]	OR [6]	YES
1st [a]	H [5]	OR [6]	H [5]	OR [6]	NE [4]		YES
2nd [a]	OR [6]	OR [6]	H [5]	OR [6]	NE [4]		YES

3rd [a]	H [5]	OR [6]	OR [6]	OR [6]	H [5]	OR [6]	YES
4th [a]	H [5]	OR [6]	OR [6]	OR [6]	OR [6]	OR [6]	YES
MAN. 3rd	H [5]	OR [6]	OR [6]	OR [6]	H [5]	OR [6]	YES
MAN. 2ND	OR [6]	OR [6]	H [5]	OR [6]	NE [4]		YES
MAN. 1ST	H [5]	OR [6]	H [5]	OR [6]	NE [4]		YES

[5] H = Hold
[6] OR = Overrunning
[7] ORI = Overrunning but independent for speed
[4] NE = No effect

Line Pressure Chart

Range	Idle	WOT Stall	Idle	WOT Stall
	PC C	PC C	Line	Line
P/N	0-103 kPa (0-15 psi)	0-103 kPa (0-15 psi)	862-1,137 kPa (125-165 psi)	2,000-2,482 kPa (290-360 psi)
R	793 kPa (115 psi)	793 kPa (115 psi)	758-1,034 kPa (110-150 psi)	1,448-1,793 kPa (210-260 psi)
D5/D4	0-103 kPa (0-15 psi)	0-103 kPa (0-15 psi)	758-1,034 kPa (110-150 psi)	1,448-1,793 kPa (210-260 psi)
M5/M4	0-103 kPa (0-15 psi)	0-103 kPa (0-15 psi)	425-800 kPa (76-116 psi)	1,448-1,793 kPa (210-260 psi)
M3	0-103 kPa (0-15 psi)	0-103 kPa (0-15 psi)	758-1,034 kPa (110-150 psi)	1,448-1,793 kPa (210-260 psi)
M2/M1	0-103 kPa (0-15 psi)	0-103 kPa (0-15 psi)	634-910 kPa (92-132 psi)	1,448-1,793 kPa (210-260 psi)
P/N	0-103 kPa (0-15 psi)	0-103 kPa (0-15 psi)	862-1,137 kPa (125-165 psi)	
R	793 kPa (115 psi)	793 kPa (115 psi)	634-910 kPa (92-132 psi)	2,000-2,482 kPa (290-360 psi)
D5/D4	0-103 kPa (0-15 psi)	0-103 kPa (0-15 psi)	758-1,034 kPa (110-150 psi)	1,448-1,793 kPa (210-260 psi)
M5/M4	0-103 kPa (0-15 psi)	0-103 kPa (0-15 psi)	758-1,034 kPa (110-150 psi)	1,448-1,793 kPa (210-260 psi)
M3/M2/M1	0-103 kPa (0-15 psi)	0-103 kPa (0-15 psi)	758-1,034 kPa (110-150 psi)	1,448-1,793 kPa (210-260 psi)

Stall Speed

Vehicle	Engine	rpm
Lincoln LS	3.0	2,565-3,060
Lincoln LS	3.9	2,491-2,900

Shift Speeds

⚠ **CAUTION:Always obey local traffic laws. Do not exceed posted limits.**

D5 PositionSpeed km/h (mph)Vehicle InformationTransmission ModelThrottle PositionShiftAxle Ratio All Lincoln LS 3.0L/3.9LRJL-AClosed5-438-41 (24-26) RJL-B 4-328-32 (18-20) 3-217-22 (11-14) 2-111-16 (7-10) Minimum Monitor PID: TP volt-1.251-314-25 (9-16) 3-432-41 (20-26) 4-541-48 (26-30) 5-445-48 (28-30) 4-328-32 (18-20) 3-217-22 (11-14) 2-111-16 (7-10) Wide Open1-267-72 (42-45) 2-390-96 (56-60) 3-4136-159 (85-99) 4-5188-236 (117-147) 5-4177-201 (110-125) 4-3123-125 (77-78) 3-256-67 (35-42) 2-138-41 (24-26)

Transmission Description

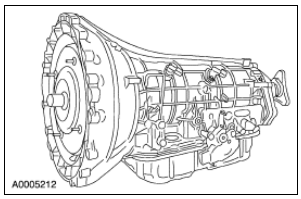
The 5R55N has the following features:

- five forward speeds
- electronic shift, pressure, and torque converter clutch controls
- three compound planetary gearsets
- three bands
- four multi-plate clutches
- three one-way clutches

All hydraulic functions are directed by electronic solenoids to control:

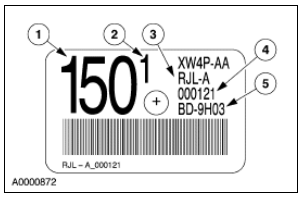
- static engagement feel.
- shift feel.
- shift scheduling.
- modulated torque converter clutch (TCC) applications.
- engine braking utilizing the coast clutch and band.
- manual first and second timing.
- reverse inhibit timing.

Transmission View



Identification Tags

I. D. Tag Located on Transmission Case



Item	Part Number	Description
1		Model number
2		Assemble level
3		Build code
4		Serial number
5		Build date (YMDD)

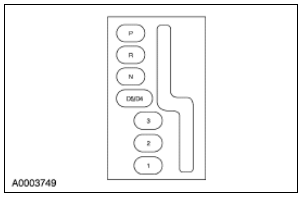
All vehicles are equipped with a Vehicle Certification Label, located on the driver side door lock post. Refer to the code in the space marked TR. For model, service ID level or build date information refer to the transmission service ID tag located on the transmission case.

Range Selection

Depending on the vehicle options selected the transmission range selector may have different range positions.

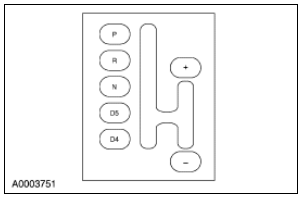
The standard range selector has eight positions: P, R, N, D5, D4, 3, 2, and 1.

Base Range Shifter



The optional Select Shift Transmission (SST) range selector has seven positions P, R, N, D5, or D4, + and -. This option will allow the driver to manually upshift and downshift into any gear range.

Optional Range Shifter



Park

In the PARK position:

- there is no power flow through the transmission.
- the parking pawl locks the output shaft to the case.
- the engine may be started.
- the ignition key may be removed.

Reverse

In the REVERSE position:

- the vehicle may be operated in a rearward direction, at a reduced gear ratio.
- backup lamps are illuminated.

Neutral

In the NEUTRAL position:

- there is no power flow through the transmission.
- the output shaft is not held and is free to turn.
- the engine may be started.

D5 (Overdrive)

D5 (overdrive) is the normal position for most forward driving.

The D5 (overdrive) position provides:

- automatic shift 1-5 and 5-1.
- apply and release of the torque converter clutch.
- maximum fuel economy during normal operation.
- engine braking in 5th gear.

D4 (Overdrive Canceled)

The D4 (overdrive) position provides:

- automatic shift 1-4 and 4-1.
- apply and release of the torque converter clutch.
- engine braking in 4th gear.

Third Position 3rd Gear (Base Shifter)

The 3rd position provides:

- third gear start and hold.
- the torque converter clutch may apply and release.
- improved traction on slippery roads.
- engine braking.

Second Position 2nd Gear (Base Shifter)

The 2nd position provides:

- second gear start and hold.
- the torque converter clutch may apply and release.
- improved traction on slippery roads.
- engine braking.

First Position 1st Gear (Base Shifter)

If this position is selected at normal road speeds, the transmission will downshift into the next lower gear and continue downshifting until the vehicle reaches first gear.

This position provides:

- first gear operation only.
- engine braking for descending steep grades.

+ and - Position Operation (Optional Shifter)

These positions allow the driver to manually select the appropriate upshift (+) or downshift (-) and gear range.

- Can only be entered from the D5 position.
- Gear ranges 1-5 provide the same function and ratio as found in the D5 or D4 automatic mode positions.
- Transmission will not upshift or downshift unless the selector lever is moved forward or rearward.
- One tap forward (+) will command the transmission to upshift one gear range.

- One tap rearward (-) will command the transmission to downshift one gear range.
- Upshifts are allowed at any vehicle speed.
- A second gear start up is normal. A third gear start up will be allowed only if selected. All other selections will revert to second gear.
- If the driver starts in second gear and does not pass 60% throttle, the transmission will remain in second gear. No automatic shift will occur.
- If the driver passes 60% throttle, then a 2-1 automatic kickdown will occur, scheduled by the PCM as used in D5. Once this has occurred, first gear will hold until second gear is selected by the driver moving the shift handle. No automatic upshift is possible under this condition.
- Once a kickdown has occurred, manual shifting in and out of first gear is allowed until the next time the vehicle stops.
- A shift to first gear with the vehicle at rest is never allowed.
- When downshifting at normal road speeds, the transmission will only allow a downshift into the next lower gear.
- If the shifter (-) is tapped more than once in rapid succession, the transmission will downshift only into the next lower gear. Then when the vehicle reaches a speed below a calibrated entry speed, the transmission will allow a downshift into the next lower gear, if again selected by the driver. This is to prevent engine and transmission damage and to keep the engine and transmission within allowable rpm ranges.
- An electronic indicator on the instrument cluster will display the selected gear.

Park Sense Switch

The park sense switch prevents the redundant PRNDL from displaying "P" until the shifter is in the park position.

Electronic Transmission Error Indicator

The vehicle is equipped with a redundant electronic gearshift indicator. This character appears with the key in the run position and displays the same gear selection as shown on the range selector floor console next to the range selector lever. If an "E" character flashes or remains on this indicates a transmission malfunction.

Shift Patterns

Upshifts

Transmission upshifting is controlled by the powertrain control module. The PCM receives inputs from various engine or vehicle sensors and driver demands to control shift scheduling, shift feel and torque converter clutch (TCC) operation.

The PCM has an adaptive learn strategy to electronically control the transmission which will automatically adjust the shift feel. When the battery has been disconnected, or a new battery installed certain transmission operating parameters may be lost. The Powertrain Control Module (PCM) must re-learn these parameters. During this learning process you may experience slightly firm shifts, delayed, or early shifts. This operation is considered normal and will not affect the function of the transmission. Normal operation will return once these parameters are stored by the PCM.

Downshifts

Under certain conditions the transmission will downshift automatically to a lower gear range (without moving the gearshift lever). There are three categories of automatic downshifts: coastdown, torque demand and forced or kickdown shifts.

Coastdown

The coastdown downshift occurs when the vehicle is coasting down to a stop.

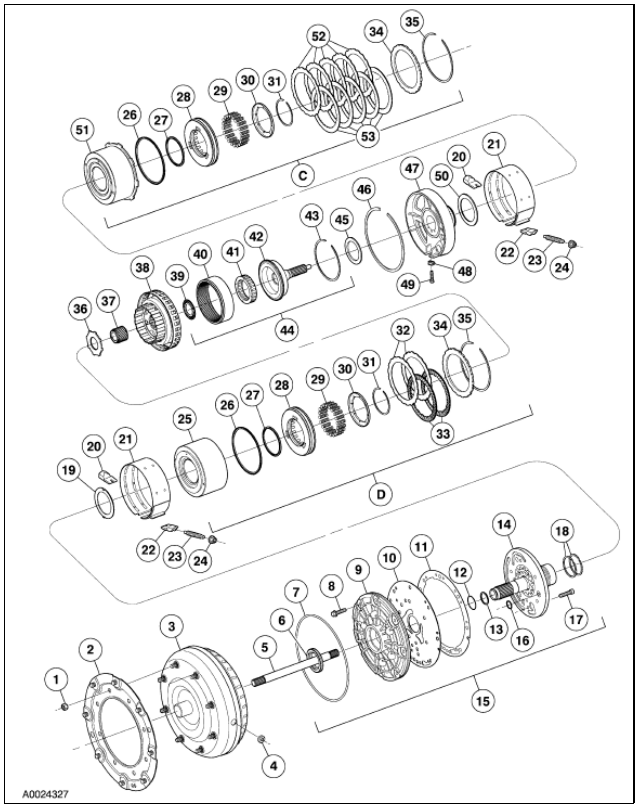
Torque Demand

The torque demand downshift occurs (automatically) during part throttle acceleration when the demand for torque is greater than the engine can provide at that gear ratio. If applied, the transmission will disengage the TCC to provide added acceleration.

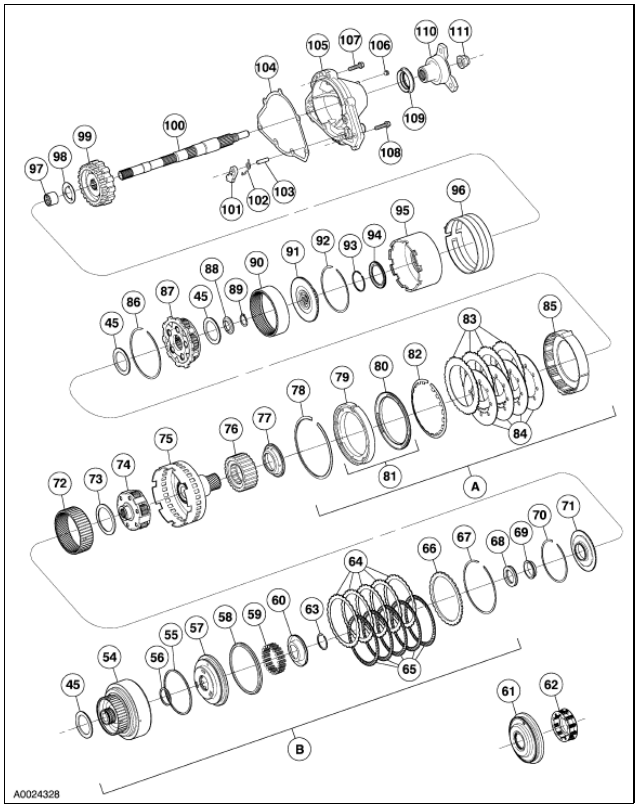
Kickdown

For maximum acceleration, the driver can force a downshift by pressing the accelerator pedal to the floor. A forced downshift into a lower gear is possible below calibrated speeds. Specifications for downshift speeds are subject to variations due to tire size and engine and transmission calibration requirements.

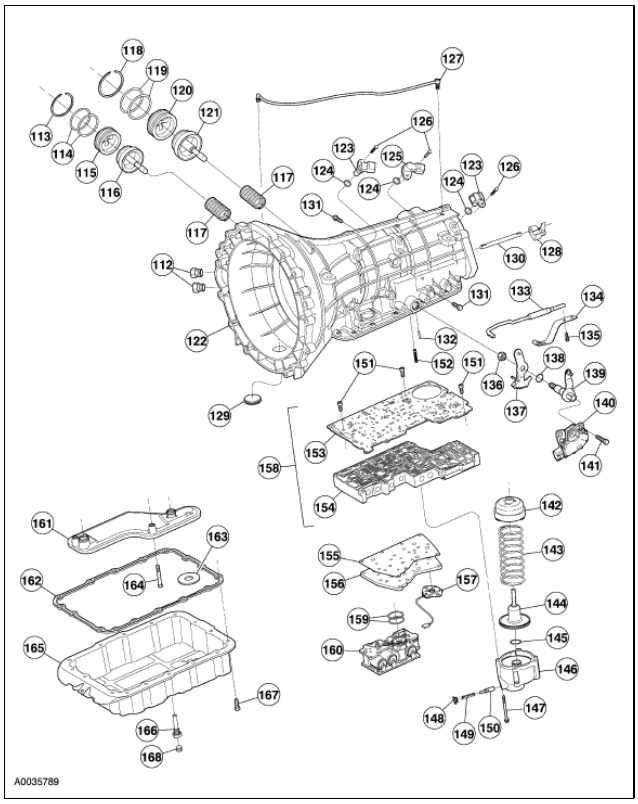
Disassembled Views



Disassembled Views (Continued)



Disassembled Views (Continued)



Item	Part Number	Description
1	6441	Nut converter to flex plate
2	6K374	Flex plate adapter assembly
3	7902	Converter assembly
4	6730	Torque converter drain plug
5	7017	Input shaft
6	7A248	Front fluid pump seal assembly
7	7A248	Front fluid pump seal
8	W704892-S1300	Screw and washer assembly M8 x 35 (attaches pump to case) (8 req'd)
9	7G178	Fluid pump cover assembly
10	7B472	Fluid pump adapter plate
11	7A136	Front fluid pump gasket
12	W701431-S300	O-ring seal fluid pump shaft to inner gear (also in pump assembly)
13	7L323	Stator support seal
14	7A108	Front pump support assembly
15	7A103	Fluid pump assembly
16	7H416	Ring
17	W701429-S309M	Bolt M8 x 1 x 35 int lob (attaches pump support to pump assembly) (6 req'd)
18	7D025	Overdrive brake drum seal
19	7D014	Washer fluid pump input thrust (select fit) No. 1
20	7D029	

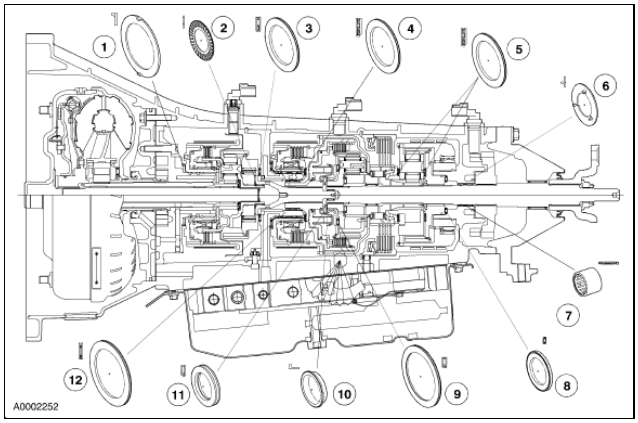
		Strut intermediate and overdrive brake band anchor (2 req'd)
21	7D034	Band assembly intermediate and overdrive brake band (2 req'd)
22	7D029	Strut intermediate and overdrive brake band apply (2 req'd)
23	7C492	Overdrive/intermediate band adjusting screw
24	71000	Overdrive/intermediate locking nut
25	7L669	Overdrive brake band drum assembly
26	7A548	Seal direct and overdrive piston outer
27	7D404	Seal direct and overdrive piston inner
28	7A262	Direct and overdrive clutch piston
29	7A480	Spring direct and overdrive clutch piston
30	7A527	Retainer clutch piston springs (2 req'd)
31	E860125-S	Retaining ring (retains 7D041 to drum) (2 req'd)
32	7B442	Plate coast clutch external splined (steel) (2 req'd)
33	7B164	Plate coast clutch internal splined (friction) (2 req'd)
34	7B066	Plate coast and direct clutch pressure (2 req'd)
35	E860126-S	Retaining ring coast and direct clutch plates (select fit) (2 req'd)
36	7660	Adapter coast clutch to overdrive carrier
37	7D063	Gear sun overdrive
38	7B446	Carrier planetary gear overdrive (with trigger wheel)
39	7L495	Bearing overdrive planet thrust No. 2
40	7A153	Gear overdrive ring
41	7A089	Overdrive one-way clutch assembly (part of 7L678)
42	7A658	Overdrive center shaft assembly
43	W702037-S300	Retaining ring (retains 7A658 to 7A153)
44	7L678	Hub and ring gear assembly (includes 7A089, 7A153, 7A658, and W702037-S300)
45	7M153	Bearing assembly center shaft and forward clutch cylinder No. 3, No. 5, No. 8 and No. 9 (4 req'd)
46	W702465-S300	Retaining ring
47	7A130	Support center
48	E826160-S76	Nut and cage assembly (attaches center support to case)
49	W705407-S300	Screw
50	7D014	Bearing assembly intermediate clutch drum (select fit) No. 4
51	7D044	Drum assembly intermediate brake
52	7B442	Plate assembly direct clutch external splined steel (5 req'd)
53	7B164	Plate assembly direct clutch internal splined friction (5 req'd)

54	7A360	Cylinder assembly forward clutch
55	7A548	Seal forward clutch piston outer
56	7A548	Seal forward clutch piston inner
57	7A262	Piston assembly forward clutch
58	7B070	Spring forward clutch cushion
59	7C151	Spring forward clutch cushion (15 req'd)
60	7A527	Retainer forward clutch piston spring
61	7A262	Piston assembly forward clutch
62	7G299	Support and spring assembly forward clutch
63	E860109-S	Retaining ring external spline
64	7B442	Plate forward clutch external spline (steel) (5 req'd)
65	7B164	Plate forward clutch internally spline (friction) (5 req'd)
66	7B066	Plate forward clutch pressure
67	7D483	Retaining ring 141.45 x 1.37 internal (select fit)
68	7D234	Bearing forward ring gear hub thrust No. 6A
69	7D090	Washer forward clutch thrust No. 6B
70	7G375	Ring forward clutch hub retainer
71	7B067	Hub forward ring gear
72	7D392	Gear forward ring
73	7G433	Bearing forward planet thrust No. 7
74	7A398	Planet assembly forward
75	7A019	Shell and sun gear assembly
76	7A089	Sprag clutch and race assembly
77	7C167	Spacer low and reverse gear
78	7D483	Ring bevel retaining
79	7G384	Housing assembly intermediate clutch (part of 7N060)
80	7E005	Piston intermediate clutch (part of 7N060)
81	7N060	Intermediate clutch assembly
82	7B070	Spring intermediate clutch piston
83	7B442	Plate intermediate clutch external spline (steel) (4 req'd)
84	7B164	Plate intermediate clutch internal spline (friction) (4 req'd)
85	7F340	Cylinder intermediate clutch
86	W702775-S300	Snap ring reverse carrier drum
87	7D006	Planet assembly reverse
88	7B167	Sleeve output shaft
89	E860527-S	Retainer ring external
90	7A153	Gear output shaft ring
91	7D164	Hub output shaft
92	7C122	Ring output shaft ring gear retaining
93	7D019	Seal output shaft hub

94	7H027	Bearing assembly low/intermediate sun gear No. 10
95	7C498	Drum and clutch assembly reverse brake (includes OWC)
96	7D095	Band assembly reverse
97	7R205	Bearing output shaft to case
98	7B368	Washer output shaft thrust No. 11
99	7A233	Gear assembly transmission parking
100	7060	Shaft assembly output
101	7A441	Pawl parking
102	7D070	Spring parking pawl return
103	7D071	Shaft parking pawl
104	7086	Gasket extension housing
105	7A039	Extension housing
106	6026	Plug fluid fill access
107	W500312-S1309	Bolt M8 x 45 extension housing to case (2 req'd)
108	W500311-S1427	Bolt M8 x 1.2 extension housing to case (5 req'd)
109	7052	Seal extension housing
110	7089	Flange output shaft
111	W701357-S309	Nut M20 x 1.5 retains flange to output shaft
112	7D273	Connector assembly fluid tube (2 req'd)
113	7H074	Ring overdrive servo retainer
114	W703119-S300	Seal overdrive servo cover (quantity model-dependent)
115	7D027	Cover overdrive servo
116	7D021	Piston and rod overdrive servo
117	7D028	Spring intermediate/overdrive servo piston (2 req'd)
118	W702777-S300	Ring intermediate servo retainer
119	W702969-S300	Seal intermediate servo cover (quantity model-dependent)
120	7D027	Cover intermediate servo
121	7D021	Piston and rod intermediate servo
122	7005	Case assembly
123	7H103	Sensor output shaft speed and turbine shaft speed
124	W702981-S300	O-ring seal speed sensor to case (3 req'd)
125	7M183	Sensor assembly intermediate shaft speed (ISS)
126	W702769-S300	Screw M6 x 19 (sensor to case)
127	7034	Vent assembly case
128	7A179	Lever assembly reverse brake drum
129	7N171	Converter housing access plug
130	7D433	Shaft reverse band actuating lever
131	390318-S2	Pipe plug
132	7B210	Pin retainer manual lever shaft
133	7A232	Rod parking pawl actuating

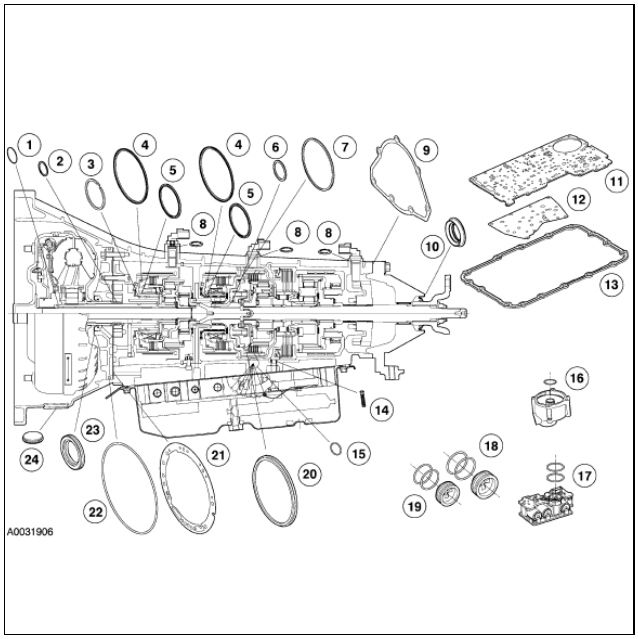
134	7E332	Spring assembly manual valve detent
135	E800185-S	Bolt detent spring
136	W703001-S309	Nut manual lever shaft
137	7C494	Lever manual valve inner
138	7B498	Seal manual control lever
139	7A256	Lever manual control
140	7F293	Sensor assembly digital transmission range (TR)
141	N806933-S100	Bolt and washer assembly digital transmission range (TR) sensor (2 req'd)
142	7D372	Plate servo reverse
143	7D466	Spring reverse servo accumulator
144	7D189	Piston and seal assembly reverse servo
145	7423	O-ring seal reverse servo piston
146	7D036	Cover reverse servo
147	W703135-S1300	Bolt (attaches reverse servo piston to case) (4 req'd)
148	7D321	Retainer control valve spring
149	7A270	Spring main fluid pressure regulator valve
150	7D488	Valve reverse servo check
151	W701099-S1430	Screw attaches separating plate to main control
152	7H003	Tube intermediate clutch fluid inlet
153	7Z490	Plate assembly valve body separator plate with bonded gasket
154	7A101	Control assembly lower main
155	7H173	Gasket valve body cover plate
156	7A008	Plate valve body cover
157	7E440	Switch assembly pressure
158	7A100	Control valve body main (includes 7Z490 and 7A101)
159	W705928	O-ring seal solenoid body connector
160	7G391	Body assembly transmission control solenoid
161	7A098	Filter transmission fluid pan
162	7A191	Gasket fluid pan
163	7L027	Magnet fluid pan
164	W705559-S300	Bolt (attaches filter to main control) (2 req'd)
165	7A194	Pan transmission fluid
166	7A010	Tube fluid drain
167	W500213-S1309	Fluid pan bolt
168	W704999-S309	Plug short hex
A		Intermediate clutch assembly
B		Forward clutch assembly
C		Direct clutch assembly
D		Coast clutch assembly

Bushings, Bearing and Thrust Washer Locator



Item	Part Number	Description
1	7D014	Front pump support thrust washer No. 1
2	7L495	Overdrive planetary thrust bearing No. 2
3	7M153	Center shaft and forward clutch cylinder bearing No. 3
4	7M153	Center shaft and forward clutch cylinder bearing No. 5
5	7M153	Center shaft and forward clutch cylinder No. 8, 9
6	7B368	Output shaft thrust washer No. 11
7	7R205	Output shaft to case bearing
8	7H027	Low/intermediate sun gear bearing No. 10
9	7G433	Forward planetary thrust bearing No. 7
10	7D090	Forward clutch hub thrust washer No. 6B
11	7D234	Forward ring gear hub thrust bearing No. 6A
12	7D014	Intermediate clutch drum bearing No. 4

Seals, Rings and Gaskets Locator



Item	Part Number	Description
1	7L323	Stator support seal
2	W701431-S300	Seal ring
3	7D025	Overdrive brake drum seal
4	7A548	Direct and overdrive piston outer seal
5	7D404	Direct and overdrive piston inner seal
6		Forward clutch piston inner seal
7		Forward clutch piston outer seal (part of 7A262)
8	W702981-S300	O-ring seal (OSS)
9	7086	Extension housing gasket
10	7052	Extension housing seal
11	7Z490	Valve body separator plate
12	7H173	Valve body cover plate gasket
13	7A191	Gasket (fluid pan)
14	7H003	Intermediate clutch fluid inlet tube
15	7B498	Manual control lever seal
16	7423	Reverse servo piston O-ring seal
17	W705928	Solenoid body connector O-ring seal (2 req'd)
18	W702969-S300	Intermediate servo cover seal
19	W703119-S300	Overdrive servo cover seal
20	7B070	Forward clutch piston cushion spring (part of 7A262)
21	7A136	Front fluid pump gasket
22	7A248	Front fluid pump seal
23	7A248	Front fluid pump seal assembly

24	7N171	Converter housing access plug

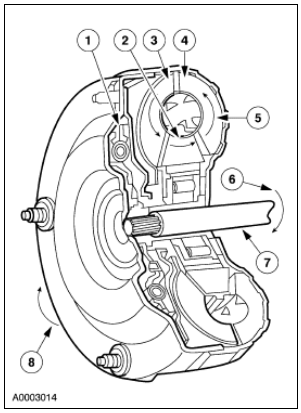
Torque Converter

The torque converter transmits and multiplies torque. The torque converter is a four-element device:

- impeller assembly
- turbine and damper assembly
- reactor assembly
- clutch

The standard torque converter components operate as follows:

- Rotation of the converter housing and impeller set the fluid in motion.
- The turbine reacts to the fluid motion from the impeller, transferring rotation to the geartrain through the input shaft.
- The reactor redirects fluid going back into the impeller, allowing for torque multiplication.
- The clutch and damper assembly dampens powertrain torsional vibration and provides a direct mechanical connection for improved efficiency.
- Power is transmitted from the torque converter to the planetary gearsets and other components through the input shaft.



Item	Part Number	Description
1		Converter clutch and damper (part of 7902)
2		Reactor (part of 7902)
3		Turbine damper (part of 7902)
4		Impeller (part of 7902)
5		Fluid motion
6		Transmission input rotation
7		Input shaft
8		Engine rotation

Geartrain

Power is transmitted from the torque converter to the planetary gearsets through the input shaft. Bands and clutches are used to hold and drive certain combinations of gearsets. This results in five forward ratios and one reverse ratio, which are transmitted to the output shaft and differential.

Gear Ratio	
1st	3.25 to 1
2nd Early Production Vehicles	2.44 to 1
2nd Late Production Vehicles	2.29 to 1
3rd	1.55 to 1
4th	1.00 to 1
5th Early Production Vehicles	0.75 to 1
5th Late Production Vehicles	0.71 to 1
Reverse	3.07 to 1

Planetary Gearset Overdrive

For component location, refer to Disassembled Views in this section.

The planetary gear overdrive carrier is driven by the input shaft.

- The overdrive planetary gearset carrier drives the center shaft via the overdrive one-way clutch in 1st, 3rd, 4th, and reverse gears.
- In 2nd, and 5th, the overdrive sun gear is held causing the pinion gears to rotate around the overdrive sun gear.
- The pinion gears in turn drive the overdrive ring gear resulting in the 5th (overdrive) gear ratio.
- The overdrive planetary gearset is internally splined to the coast clutch for engine braking.

Planetary Gearset Forward

For component location, refer to Disassembled Views in this section.

The forward planetary gearset is splined to the output shaft.

- The forward planetary gearset is driven by the forward ring gear when the forward clutch is applied.
- The forward planetary gearset pinions drive the forward sun gear.
- The forward sun gear is splined to the input shell.
- The forward carrier is splined to the output shaft.

Planetary Gearset Low/Reverse

For component location, refer to Disassembled Views in this section.

The low/reverse planetary gearset is connected to the reverse brake drum by lugs from the low/reverse brake drum to the lugs of the low/reverse planetary gearset.

- The low/reverse planetary gearset is driven by the forward sun gear which is splined to the input shell.
- The forward sun gear drives the pinions in the low/reverse planetary gearset.
- The pinions of the low/reverse planetary gearset drive the output shaft ring gear and output shaft hub which is splined to the output shaft.
- The low/reverse planetary gearset can be held by the low one-way clutch in the low/reverse brake drum, or by the low/reverse band.

Input Shaft

For component location, refer to Disassembled Views in this section.

- The radial positioning of the input shaft is controlled by two bushings in the stator support.
- Axial positioning of the input shaft is controlled by the splines in the converter turbine and the retaining ring in the overdrive planetary carrier.

Output Shaft

For component location, refer to Disassembled Views in this section.

The output shaft is supported by a bearing in the case and by a bearing in the extension housing. End positioning is controlled by the parking pawl gear and by the reverse ring gear hub and snap ring.

Apply Components

Band Overdrive

For component location, refer to Disassembled Views in this section.

During 2nd and 5th gear operation, hydraulic pressure is applied to the overdrive servo.

- This pressure causes the piston to move and apply force to the band.
- This action causes the overdrive band to hold the overdrive drum.
- This causes the overdrive sun gear to be held stationary through the adapter plate and the overdrive drum.

Band Low/Reverse

For component location, refer to Disassembled Views in this section.

During 2nd gear operation, 1st gear operation and reverse, hydraulic pressure is applied to the low/reverse servo.

- This pressure causes the servo to move and apply force to the low/reverse band.
- This action causes the low/reverse brake drum to be held.
- This action causes the low/reverse planetary assembly to be held stationary.

Band Intermediate

For component location, refer to Disassembled Views in this section.

During 3rd gear operation, hydraulic pressure is applied to the intermediate servo.

- This pressure causes the servo to move and apply force to the intermediate band.
- This action causes the direct clutch drum to be held.
- The intermediate band holds the intermediate brake and direct clutch drum to the case in 3rd gear.
- This causes the input shell and forward sun gear to be held stationary.

Clutches Direct

For component location, refer to Disassembled Views in this section.

The direct clutch is a multi-disc clutch made up of steel and friction plates.

- The direct clutch is applied with hydraulic pressure and disengaged by return springs and the exhaust of the hydraulic pressure.
- It is housed in the direct clutch drum.
- During 4th, 5th, and reverse gear application, the direct clutch is applied transferring torque from the forward clutch cylinder to the direct clutch drum.
- This action causes the forward sun gear to drive the pinions of the low/reverse planetary carrier.

Clutches Forward

For component location, refer to Disassembled Views in this section.

The forward clutch is a multi-disc clutch made up of steel and friction plates.

- The forward clutch is applied with hydraulic pressure and disengaged by return springs and the exhaust of the hydraulic pressure.
- The forward clutch is applied in all forward gears.
- When applied, the forward clutch provides a direct mechanical coupling between the center shaft and the forward ring gear and hub.

Clutches Coast

For component location, refer to Disassembled Views in this section.

The coast clutch is a multi-disc clutch made up of steel and friction plates.

- The coast clutch is applied with hydraulic pressure and disengaged by return springs and the exhaust of the hydraulic pressure.
- The coast clutch is housed in the overdrive drum.
- The coast clutch is applied when in 1st, 3rd, D4, and reverse positions.
- When applied, the coast clutch locks the overdrive sun gear to the overdrive planetary carrier, thus preventing the one-way clutch from overrunning when the vehicle is coasting.
    - ♦ This allows the use of engine compression to help slow the vehicle and provide engine braking.

Clutches Intermediate

For component location, refer to Disassembled Views in this section.

The intermediate clutch is a multi-disc stationary clutch made up of steel and friction plates which are in a module assembly that includes the cylinder and frictions.

- Applied with hydraulic pressure.
- Disengaged by a return spring and releasing of hydraulic pressure.
- Hydraulic pressure is feed through a feed tube in the case worm trail.
- Uses a bonded piston in an aluminum housing.
- Applied in during a 2-3 shift event.
- Transfers torque from the sun gear to the planetary carrier.
- Torque transfer causes the one way clutch to engage and holds the sun gear from turning, delivering 3rd gear.

One-Way Clutch Direct

For component location, refer to Disassembled Views in this section.

The direct one-way clutch is a sprag-type one-way clutch that is pressed into the center shaft.

- The direct one-way clutch is driven by the ring gear of the overdrive planetary carrier.
- The direct one-way clutch holds and drives the outer splines of the center shaft in 1st, 3rd, 4th and reverse gears.
- The direct one-way clutch overruns during all coast operations and at all times in 2nd and 5th gear.

One-Way Clutch Intermediate

For component location, refer to Disassembled Views in this section.

The Intermediate One-Way Clutch is a sprag type one-way clutch.

- The Intermediate One-Way Clutch connects the intermediate assembly to the input shell and sun gear assembly in third gear.

One-Way Clutch Low/Reverse

For component location, refer to Disassembled Views in this section.

The low/reverse one-way clutch is a sprag type one-way clutch.

- The low/reverse one-way clutch holds the low/reverse drum and low/reverse planetary assembly to the case in 1st and 2nd gear.
- In all other gears the low/reverse one-way clutch overruns.

Hydraulic System

Fluid Pump

For component location, refer to Disassembled Views in this section.

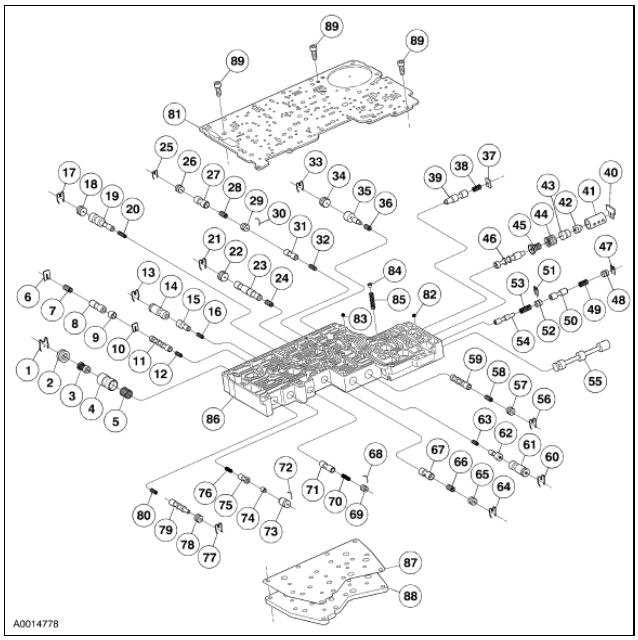
- The fluid pump provides the fluid pressure necessary to charge the torque converter, main control assembly, transmission cooling system, lubrication system and apply devices.
- The fluid pump is a positive displacement, gear type pump.
  - The fluid pump is driven by the torque converter impeller hub.

Filter

For component location, refer to Disassembled Views in this section.

- All fluid drawn from the transmission fluid pan by the fluid pump passes through the fluid filter.
- The transmission fluid filter and its accompanying seals are part of the fluid path from the sump (pan) to the fluid pump.
  - The transmission fluid filter has a bypass section which allows fluid vented at the main regulator valve to be recirculated to the fluid pump, without passing through the transmission fluid filter.

Main Control



Item	Part Number	Description
1	7F445	Clip retainer
2	7D374	Plug retainer
3	7M094	Valve assembly thermo
4	7L367	Valve fluid cooler bypass
5	7M116	Spring fluid cooler bypass
6	7E336	Plate

7	7G489	Spring coast clutch control
8	7G490	Valve coast clutch control
9	7G490	Valve coast clutch control
10	7E336	Plate
11	7M189	Valve overdrive servo control
12	7M193	Spring overdrive servo control valve
13	7M445	Clip retainer
14	7D374	Plug retainer
15	7M095	Valve modulator
16	7M104	Spring modulator valve
17	7F445	Plug retainer
18	7D374	Clip retainer
19	7F259	Valve 4-3 ISR downshift control
20	7F260	Spring 4-3 ISR control valve
21	7F445	Plug retainer
22	7D374	Clip retainer
23	7M188	Valve 4-3 pre-stroke intermediate band control
24	7G289	Spring 4-3 pre-stroke intermediate band control valve
25	7F445	Clip retainer
26	7D374	Plug retainer
27	7G317	Valve reverse engagement
28	7D312	Spring reverse engagement valve
29	7D374	Plug retainer
30	7D335	Retainer wire
31	7M187	Valve high clutch control
32	7M192	Spring high clutch control valve
33	7F445	Clip retainer
34	7D374	Plug retainer
35	7M095	Valve reverse modulator
36	7M104	Spring reverse modulator valve
37	7E336	Plate
38	7M191	Spring rear servo control valve
39	7M098	Valve rear servo control
40	7E336	Plate
41	7D002	Sleeve
42	7D003	Valve booster
43	7D003	Valve booster
44	7A270	Spring outer
45	7H149	Spring and retainer assembly
46	7C388	Valve main regulator
47	7F445	Retainer clip
48	7D374	Retainer plug
49	7L317	Spring reverse inhibition valve

50	7L316	Valve reverse inhibition
51	7E445	Retainer clip
52	7D374	Retainer plug
53	7G411	Spring solenoid regulator valve
54	7G473	Valve solenoid regulator
55	7340	Valve manual
56	7F445	Retainer clip
57	7D374	Retainer plug
58	7M009	Spring select valve
59	7M186	Spring select
60	7F445	Retainer clip
61	7D374	Retainer plug
62	7M095	Valve modulator
63	7M104	Spring modulator valve
64	7A445	Retainer clip
65	7D374	Retainer plug
66	7G312	Spring forward engagement control valve
67	7D317	Valve forward engagement control
68	7E335	Retainer wire
69	7D374	Retainer plug
70	7M190	Spring back pressure
71	7M185	Valve converter clutch back pressure
72	7E335	Retainer wire
73	7D002	Sleeve converter clutch modulator control
74	7M184	Valve converter clutch modulator control
75	7G307	Valve converter clutch modulator
76	7G316	Spring converter clutch modulator control
77	7F445	Retainer clip
78	7D374	Retainer plug
79	7L318	Valve converter clutch control
80	7L490	Spring converter clutch control valve
81	7Z490	Plate assembly main control valve body separator
82	7E195	Ball lubrication check
83	7E195	Ball shuttle valve
84	7E368	Valve limit
85	7E340	Spring limit valve
86	7A101	Body control valve lower
87	7H173	Gasket valve body cover plate
88	7C034	Plate valve body cover
89	W701099-S1430	Screw separator plate

- The main control assembly and related components are part of the pressure side of the hydraulic system.
- The main control assembly consists of the solenoids, the valve body assembly and the separator plate.
- These components combine to convert electrical signals into hydraulic actions.

- All valves in the main control assembly are anodized aluminum and cannot be sanded, filed, or dressed in any other way. If there is any damage to the valves that prevents or restricts their movement, install a new main control assembly.

Transmission Electronic Control System

Electronic System Description

The powertrain control module and its input/output network control the following transmission operations:

- shift timing.
- line pressure (shift feel).
- torque converter clutch.

The transmission control strategy combined with the engine control provides optimum powertrain operation under all conditions. When determining the best operating strategy for transmission operation, the PCM uses input information from certain engine-related and driver-demand related sensors and switches.

In addition, the PCM receives input signals from certain transmission-related sensors and switches. The PCM also uses these signals when determining transmission operating strategy.

Using all of these input signals, the PCM can determine when the time and conditions are right for a shift, or when to apply or release the torque converter clutch. It will also determine the pressure needed to optimize shift feel. To accomplish this the PCM uses three pressure controls, one torque converter clutch and four shift solenoids to control transmission operation.

The following provides a brief description of each of the sensors and actuators used to control transmission operation.

Powertrain Control Module

The operation of the transmission is controlled by the powertrain control module. Many input sensors provide information to the powertrain control module. The powertrain control module then controls the actuators which determine transmission operation.

Air Conditioning (A/C) Clutch

An electromagnetic clutch is energized when the clutch cycling pressure switch closes. The switch is located on the suction accumulator/drier. The closing of the switch completes the circuit to the clutch and draws it into engagement with the compressor driveshaft. When the A/C is engaged, operating pressures are adjusted to compensate for additional load on the engine.

Brake Pedal Position (BPP) Switch

The brake pedal position (BPP) switch tells the powertrain control module (PCM) when the brakes are applied. The torque converter clutch disengages when the brakes are applied. The BPP switch closes when the brakes are applied and opens when they are released. The BPP is also used to disengage the brake shift interlock.

Engine Coolant Temperature (ECT) Sensor

The engine coolant temperature (ECT) sensor detects engine coolant temperature and supplies the information to the PCM. The ECT sensor is used to control torque converter clutch (TCC) operation.

Electronic Ignition (EI) System

The electronic ignition consists of a crankshaft position sensor, two four-tower ignition coils and the powertrain control module. The ignition control module operates by sending crankshaft position information from the crankshaft position sensor to the ignition control module. The ignition control module generates a profile ignition pickup (PIP) signal (engine rpm) and sends it to the PCM. The PCM uses PIP signal in the transmission strategy, wide-open throttle (WOT) shift control, torque converter clutch control and operating pressures.

Intake Air Temperature (IAT) Sensor

The intake air temperature (IAT) sensor provides the sequential fuel injection (SFI) system mixture temperature information. The IAT sensor is used both as a density corrector for air flow calculation and to proportion cold enrichment fuel flow. The IAT sensor is installed in the air cleaner outlet tube. The IAT sensor is also used in determining control pressures.

Mass Air Flow (MAF) Sensor

The mass air flow sensor measures the mass of air flowing into the engine. The MAF sensor output signal is used by the powertrain control module (PCM) to calculate injector pulse width. For transmission strategies, the MAF sensor is used to regulate electronic pressure control, shift and torque converter clutch scheduling.

Transmission Control Switch (TCS)

The transmission control switch (TCS) sends a signal to the powertrain control module (PCM) when the driver selects the D4 position, canceling operation of 5th (overdrive) gear.

The TCS is located within the range selector assembly (base shifter only).

The PCM uses this signal to control the shift solenoids to disengage/disable 5th gear operation and activates coast clutch. At the same time, the PCM changes the instrument panel indicator to display D4.

When the driver moves the range selector lever back to the D5 position, 5th gear operation is enabled, the coast clutch is released and the instrument panel indicator changes to display D5.

Throttle Position (TP) Sensor

The throttle position (TP) sensor is a potentiometer mounted on the throttle body. The TP sensor detects the position of the throttle plate and sends this information to the powertrain control module. The TP sensor is used for shift scheduling, electronic pressure control and torque converter clutch (TCC) control.

Digital Transmission Range (TR) Sensor

The digital transmission range (TR) sensor is located on the outside of the transmission at the manual lever. The digital TR sensor completes the start circuit in PARK, NEUTRAL, and the back-up lamp circuit in REVERSE. The digital TR sensor also opens and closes a set of four switches that are monitored by the powertrain control module to determine the position of the manual lever (P, R, N, D5, 3, 2, 1).

Turbine Shaft Speed (TSS) Sensor

The turbine shaft speed (TSS) sensor is a magnetic pickup that sends the powertrain control module torque converter turbine speed information.

The TSS sensor is mounted externally on the case.

The PCM uses TSS information to help determine appropriate operating pressures and torque converter clutch

(TCC) operation.

Output Shaft Speed (OSS) Sensor

The output shaft speed (OSS) sensor is a magnetic pickup, located at the park gear, that sends a signal to the powertrain control module to indicate transmission output shaft speed. The OSS sensor is mounted externally on the case. The OSS is used for torque converter clutch control, speed scheduling and to determine electronic pressure control.

Intermediate Shaft Speed (ISS) Sensor

The intermediate shaft speed (ISS) sensor is a magnetic pickup that sends planetary sun gear speed information to the PCM. The ISS is mounted externally on the center of the case.

The PCM uses the ISS information to aid in determining pressure requirements.

Pressure Control Solenoids (PCA, PCB, PCC)

The pressure control (PC) solenoids are a variable-force style (VFS) solenoid. The VFS-type solenoid is an electrohydraulic actuator combining a solenoid and a regulating valve.

The line pressure tap is used to verify output pressure from PC A or PC B by turning either one off while verifying the output from the other solenoid. The second pressure tap is used to verify the output from the PC C solenoid.

There are three PC solenoids located in the solenoid body assembly used to control line pressure, band and clutch application pressure within the transmission.

The powertrain control module varies the current to the PC solenoid.

The PCM has an adaptive learn strategy to electronically control the transmission which will automatically adjust the shift feel. When the battery is disconnected or a new battery installed, certain transmission operating parameters can be lost. The Powertrain Control Module (PCM) must relearn these parameters. During this learning process, you may experience slightly firm shifts, delayed, or early shifts. This operation is considered normal and will not affect the function of the transmission. Normal operation will return once these parameters are stored by the PCM.

Torque Converter Clutch (TCC) Solenoid

The torque converter clutch (TCC) solenoid is a pulse-width-modulating type solenoid that is used to control the apply and release of the TCC.

Shift Solenoids (SSA, SSB, SSC, SSD)

Four On/Off shift solenoids allow the powertrain control module to control shift scheduling.

- The solenoids are three-way, normally open style.
- The shift solenoids SSA, SSB, SSC and SSD provide gear selection of 1st through 5th and reverse gears by directing PC pressures to the appropriate elements.

Coast braking and manual gears are also controlled by the shift solenoids.

Transmission Fluid Temperature (TFT) Sensor

- The transmission fluid temperature (TFT) sensor is a thermistor-type sensor that varies a reference voltage signal. The resistance in the TFT varies with temperature. The powertrain control module (PCM) monitors the voltage signal across the TFT, and uses this information to determine the transmission fluid temperature.
- The TFT is located on the solenoid body.
- The PCM uses the TFT signal to help determine shift scheduling, torque converter clutch operation and pressure control requirements.

It sends a voltage signal to the powertrain control module. The voltage signal varies with transmission fluid temperature. The PCM uses this signal to determine whether a cold start shift schedule is necessary. The shift schedule is compensated when the transmission fluid temperature is cold. The PCM also inhibits torque converter clutch (TCC) operation at low transmission fluid temperatures and determines pressure control (PC) solenoid operations.

Reverse Pressure (RP) Switch

The reverse pressure (RP) switch is a simple open or closed switch that is used to detect the presence of pressure in the main control valve body. The switch is mounted on the main control valve body. When pressure is not present, the switch is opened and the voltage reading is high. When pressure is present, the switch is closed and the voltage reading will be near zero.

Instrument Panel Range Selector Indicator

This indicator is an electronic readout in the instrument cluster which will match the position of the range selector (P, R, N, D4, D5, 3, 2, 1). If an error in the range selector assembly occurs, an "E" (error) will be displayed on the instrument panel.

Select Shift Transmission (SST) Switches (+ and -)

The positions indicated by a (+) or a (-) allow the driver to manually select the appropriate upshift (+) or downshift (-) and gear range.

The SST switches are located within the transmission range selector assembly and are momentary contact switches that send a signal to the PCM each time the driver moves the selector lever into the upshift or downshift gear range.

The PCM uses the input signals from the SST+ and the SST- switches, along with other vehicle inputs to determine which gear should be commanded.

Diagnostic Strategy

Troubleshooting an electronically controlled automatic transmission is simplified by using the proven method of diagnosis. One of the most important things to remember is that there is a definite procedure to follow.

NOTE: Do not take any shortcuts or assume that critical checks or adjustments have already been made.

Follow the procedures as written to avoid missing critical components or steps.

To correctly diagnose a concern, have the following publications available:

- Powertrain Control/Emissions Diagnosis (PC/ED) manual
- TSBs and OASIS messages.
- Wiring Diagram.

These publications provide the necessary information when diagnosing transmission concerns.

Use the Diagnostic Flow Chart as a guide and follow the steps as indicated.

Preliminary Inspection

- Know and understand the customer's concern.
- Verify the concern by operating the vehicle.
- Check the fluid levels and condition.
- Check for non-factory add-on items.
- Check shift linkages for correct adjustment.
- Check TSBs and OASIS messages regarding the concern.

Diagnostics

- Carry out on-board diagnostic procedures key on engine off (KOEO) and key on engine running (KOER).
- Record all diagnostic trouble codes (DTCs).
- Repair all non-transmission codes first.
- Repair all transmission codes second.
- Erase all continuous codes and attempt to repeat them.
- Repair all continuous codes.
- If only pass codes are obtained, proceed to Diagnosis by Symptom Index for further information and diagnosis.

Follow the diagnostic sequence to diagnose and repair the concern the first time.

Diagnostic Flow Chart

Diagnostic Flow Chart		
• Know and understand the customer concerns • Check the fluid level and condition • Verify the concern by operating the vehicle • Check for non-factory-installed items and verify correct installation • Check the shift linkage adjustments • Check TSBs and OASIS messages for vehicle concerns • Carry out quick test both KOER and KOEO • Record all codes 1) Did you record any Diagnostic Trouble Codes?	Yes	· REPAIR all hard Diagnostic Trouble Codes. FOLLOW the pinpoint tests. REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual first, then this workshop manual.
	No	· REFER to Diagnosis By Symptom in this section, then GO to Step 5.
2) Are any continuous test memory codes present?	Yes	· CLEAR codes and CARRY OUT drive cycle test.
	No	· GO to Step 4.
3) Did the continuous test memory codes reappear?	Yes	· REPAIR all continuous test memory codes. FOLLOW the pinpoint tests. REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual then the transmission reference manual, then this workshop manual, then GO to Step 4.
	No	· GO to Step 4.
4) Is the concern repaired?	Yes	· CARRY OUT the final quick test to verify that no Diagnostic Trouble Codes are present. CLEAR memory codes.
	No	· REFER to Diagnosis By Symptom in this section.
5) Are there any electrical concerns?	Yes	· INSTALL the NGS and CARRY OUT output state control test, then GO to Step 6.
	No	· REFER to the hydraulic and mechanical routine to diagnose and repair the concern, then GO to Step 7.

6) Was the transmission concern corrected when the NGS was installed?	Yes	· REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual, intermittent fault diagnosis section and use the NGS or WDS to diagnose cause of concern in the processor, vehicle harness or external inputs (sensors or switches).
	No	· REFER to the hydraulic and mechanical routine to diagnose the concern, then GO to Step 7.
7) Is the concern repaired?	Yes	· CARRY OUT the final quick test to verify that no diagnostic trouble codes are present. CLEAR memory codes.
	No	· GET assistance from Technical Hotline.

Preliminary Inspection

The following items must be checked prior to beginning the diagnostic procedures:

Know and Understand the Concern

In order to correctly diagnose a concern, first understand the customer complaint or condition. Customer contact may be necessary in order to begin to verify the concern. Understand the condition as to when the concern occurs, for example:

- hot or cold vehicle temperature.
- hot or cold ambient temperature.
- vehicle driving conditions.
- vehicle loaded/unloaded.

After understanding when and how the concern occurs, proceed to verify the concern.

Verification of Condition

This section provides information that must be used in both determining the actual cause of customer concerns and executing the appropriate procedures.

The following procedures must be used when verifying customer concerns for the engine.

Determine Customer Concern

NOTE: Some transmission conditions can cause engine concerns. An electronic pressure control short circuit can cause engine misfiring. The torque converter clutch not disengaging will stall the engine.

Determine customer concerns relative to vehicle use and dependent driving conditions, paying attention to the following items:

- hot or cold vehicle operating temperature
- hot or cold ambient temperatures
- type of terrain
- vehicle loaded/unloaded
- city/highway driving
- upshift
- downshift
- coasting
- engagement
- noise/vibration check for dependencies, either rpm dependent, vehicle speed dependent, shift dependent, gear dependent, range dependent, or temperature dependent.

Check Fluid Level and Condition

⚠ CAUTION: The vehicle should not be driven if the fluid level is low or internal failure could result.

NOTE: If the vehicle has been operated for an extended period of time at highway speeds, in city traffic, in hot weather, or pulling a trailer, the fluid must cool down 30 minutes to obtain an accurate reading.

This vehicle is not equipped with a fluid level indicator. An incorrect level may affect the transmission operation and can result in transmission damage. To correctly check and add fluid to the transmission, refer to Transmission Fluid Drain and Refill - Automated Equipment , Transmission Fluid Drain and Refill - Vehicles With Torque Converter Drain Plug or Transmission Fluid Drain and Refill - Vehicles Without Torque Converter Drain Plug in this section.

High Fluid Level

A fluid level that is too high can cause the fluid to become aerated due to the churning action of the rotating internal parts. This will cause erratic control pressure, foaming, loss of fluid from the vent tube and possible transmission damage. If an overfill reading is indicated, refer to Transmission Fluid Drain and Refill - Automated Equipment , Transmission Fluid Drain and Refill - Vehicles With Torque Converter Drain Plug or Transmission Fluid Drain and Refill - Vehicles Without Torque Converter Drain Plug in this section.

Low Fluid Level

A low fluid level can result in poor transmission engagement, slipping or damage. It can also indicate a leak in one of the transmission seals or gaskets.

Adding Fluid

⚠ CAUTION: The use of any type of transmission fluid other than specified can result in transmission damage.

If fluid must be added, add fluid in 0.25L (0.5 pint) increments through the fluid pan level check screw opening. Do not overfill the fluid, refer to Transmission Fluid Level Check in this section. For fluid type, refer to the General Specification chart in this section.

Fluid Condition Check

1. Check the fluid level. For additional information, refer to Transmission Fluid Drain and Refill - Automated Equipment , Transmission Fluid Drain and Refill - Vehicles With Torque Converter Drain Plug or Transmission Fluid Drain and Refill - Vehicles Without Torque Converter Drain Plug in this section.

2. Observe the color and the odor of the fluid. Under normal circumstances, the color should be dark reddish, not brown or black.

3. Allow the fluid to drip onto a facial tissue and examine the stain.

4. If evidence of solid material is found, the transmission fluid pan should be removed for further inspection.

5. If fluid contamination or transmission failure is confirmed by the sediment in the bottom of the transmission fluid pan, the transmission must be disassembled and completely cleaned.

6. Carry out diagnostic checks and adjustments. For additional information, refer to Diagnosis By Symptom in this section.

Road Testing Vehicle

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

NOTE: When the battery is disconnected or a new battery installed, certain transmission operating parameters may be lost. The powertrain control module (PCM) must relearn these parameters. During this learning process, you may experience slightly firm shifts, delayed, or early shifts. This operation is considered normal and will not affect the function of the transmission. Normal operation will return once these parameters are stored by the PCM.

The Shift Point Road Test and Torque Converter Clutch Operation Test provide diagnostic information on transmission shift controls and torque converter operation.

Shift Point Road Test

This test verifies that the shift control system is operating correctly.

1. Bring engine and transmission up to normal operating temperature.

2. Operate the vehicle with the selector lever in the D5 position.

3. Apply minimum throttle and observe the speeds at which upshift occurs and torque converter engages. Refer to the following Shift Speeds chart.

4. Stop the vehicle. Select the D4 position. Repeat Step 3. The transmission will make all upshifts except 4-5 and torque converter clutch should apply above 46 km/h (27 mph).

5. Press the accelerator pedal to the floor, wide open throttle (WOT). The transmission should shift from third to second, or third to first, depending on vehicle speed, and torque converter clutch should release.

6. With vehicle speed above 48 km/h (30 mph), move the transmission range selector lever from D4 position to first position and release the accelerator pedal. The transmission should immediately downshift to third gear. When vehicle speed drops below 32 km/h (20 mph), the transmission should downshift into first gear.

7. If transmission fails to upshift/downshift or torque converter clutch does not apply/release, refer to Diagnosis By Symptom for possible causes.

   Shift Speeds
   ⚠ **CAUTION:Always obey local traffic laws. Do not exceed posted limits.**

D5 Position	Speed km/h (mph)	Vehicle Information	Transmission Model	Throttle Position	Shift
All	Lincoln LS 3.0L/3.9L	RJL-A	Closed	5-4	38-41 (24-26) RJL-B 4-3
28-32 (18-20) 3-2	17-22 (11-14) 2-1	11-16 (7-10) Minimum Monitor PID: TP volt			1.25
1-3	14-25 (9-16) 3-4	32-41 (20-26) 4-5	41-48 (26-30) 5-4	45-48 (28-30) 4-3	28-32 (18-20) 3-2
17-22 (11-14) 2-1	11-16 (7-10) Wide Open	1	267-72 (42-45) 2-3	90-96 (56-60) 3-4	136-159 (85-99) 4-5
188-236 (117-147) 5-4	177-201 (110-125) 4-3	123-125 (77-78) 3-2	56-67 (35-42) 2-1	38-41 (24-46)	

Torque Converter Diagnosis

Prior to installing a new torque converter, all diagnostic procedures must be followed. This is to prevent the unnecessary replacement of good torque converters. Only after a complete diagnostic evaluation can the decision be made to install a new torque converter.

Begin with the normal diagnostic procedures as follows:

1. Preliminary Inspection.

2. Know and Understand the Customer Concern.

3. Verify the Concern Carry out the Torque Converter Clutch Operation Test. Refer to Torque Converter Operation Test in this section.

4. Carry out Diagnostic Procedures.

- Run on-board diagnostics; see On-Board Diagnostics With NGS, refer to Diagnostics in this section.
  - ♦ Repair all non-transmission related DTCs first.
  - ♦ Repair all transmission DTCs.
  - ♦ Rerun on-board diagnostic to verify repair.
- Carry out the Line Pressure Test. Refer to Special Testing Procedures in this section.
- Carry out the Stall Speed Test. Refer to Special Testing Procedures in this section.
- Carry out the Diagnosis by Symptom Routine for torque converter diagnosis. Refer to Diagnosis By Symptom in this section.
  - ♦ Use the index to locate the appropriate routine that best describes the symptom(s). The routine will list all possible components that may cause or contribute to the symptom. Check each component listed; diagnose and service as necessary before servicing the torque converter.

Torque Converter Operation Test

This test verifies that the torque converter clutch control system and the torque converter are operating correctly.

5. Carry out the Quick Test; see On-Board Diagnostics With NGS, refer to Diagnostics in this section. Check for DTCs. Refer to the Diagnostic Trouble Code Charts .

6. Connect a tachometer to the engine.

7. Bring the engine to normal operating temperature by driving the vehicle at highway speeds for approximately 15 minutes in D5 position.

8. After normal operating temperature is reached, maintain a constant vehicle speed of about 80 km/h (50 mph) and tap brake pedal with the left foot.

9. The engine rpm should increase when brake pedal is tapped, and decrease about five seconds after pedal is released. If this does not occur, see Torque Converter Operation Concerns, Diagnosis By Symptom .

10. If the vehicle stalls in D5 or manual 2 at idle with vehicle at a stop, move the transmission range selector lever to manual 1 position. If the vehicle stalls, see Torque Converter Operation Concerns, Diagnosis By Symptom in this section. Repair as necessary. If the vehicle does not stall in D5, refer to Diagnosis By Symptom in this section.

Visual Inspection

This inspection will identify modifications or additions to the vehicle operating system that may affect diagnosis. Inspect the vehicle for non-Ford factory add-on devices such as:

- electronic add-on items:
  - ♦ air conditioning
  - ♦ generator (alternator)
  - ♦ engine turbo
  - ♦ cellular telephone
  - ♦ cruise control
  - ♦ CB radio
  - ♦ linear booster
  - ♦ backup alarm signal
  - ♦ computer
- Vehicle modification:

These items, if not installed correctly, will affect the powertrain control module, or transmission function. Pay particular attention to add-on wiring splices in the PCM harness or transmission wiring harness, abnormal tire size, or axle ratio changes.

- leaks. Refer to Leakage Inspection in this section.
- correct linkage adjustments. Refer to Section 307-05 .

Shift Linkage Check

Check for a misadjustment in shift linkage by matching the detents in the transmission range selector lever with those in the transmission. If they match, the misadjustment is in the indicator. Do not adjust the shift linkage.

Hydraulic leakage at the manual control valve can cause delay in engagements and/or slipping while operating if the linkage is not correctly adjusted. Refer to Section 307-05 for shift linkage adjustment.

Check TSBs and OASIS

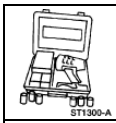
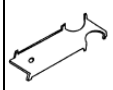
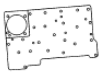
Refer to all Technical Service Bulletins and OASIS messages which pertain to the transmission concern and follow the procedure as outlined.

Carry Out On-Board Diagnostics (KOEO, KOER)

After a road test, with the vehicle warm and before disconnecting any connectors, carry out the Quick Test using New Generation Star (NGS) Tester. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the powertrain control system.

Diagnostics

Special Tool(s)

 ST1300-A	UV Leak Detector 164-R0756 or equivalent
 ST1565-A	Pressure Gauge, Transmission Fluid 307-004 (T57L-77820-A)
 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)
 ST2408-A	Air Test Plate, Transmission 307-405
 ST1137-A	73 III Automotive Meter 105-R0057 or equivalent
	Trans Tester TR/MLP Overlay and Manual 007-00131 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation Star (NGS) Tester 418-F052 or equivalent
 ST1632-A	MLP-TR Cable 418-F107 (007-00111) or equivalent
 ST1389-A	Transmission Tester 307-F016 (007-00130) or equivalent

Diagnosing electronically controlled automatic transmissions is simplified using the following procedures. It is important to remember that there is a definite procedure to follow. DO NOT TAKE SHORTCUTS OR ASSUME THAT CRITICAL CHECKS OR ADJUSTMENTS HAVE ALREADY BEEN MADE. Follow the procedures as written to avoid missing critical components or steps. By following the diagnostic sequence, the technician will be able to diagnose and repair the concern the first time.

On-Board Diagnostics with NGS

NOTE: For detailed instruction and other diagnostic methods using the NGS, refer to the NGS tester and the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

These quick tests should be used to diagnose the powertrain control module and should be carried out in order.

- Quick Test 1.0 Visual Inspection
- Quick Test 2.0 Set Up
- Quick Test 3.0 Key On, Engine Off
- Quick Test 4.0 Continuous Memory
- Quick Test 5.0 Key On, Engine Running
- Special Test Mode
    - Wiggle Test Mode
    - Output Test Mode
- PCM Reset Mode
- Clearing DTCs
- OBD II Drive Cycle
- Other NGS Features

For further information on other diagnostic testing features using the NGS or generic scan tool, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Other diagnostic methods include the following:

- Parameter Identification (PID) Access Mode
- Freeze Frame Data Access Mode
- Oxygen Sensor Monitor Mode

Output State Control (OSC) Mode

Output state control (OSC) allows the technician to control certain transmission function parameters. For example, OSC allows the technician to shift the transmission only when commanding a gear change. If the technician commands 1st gear in OSC, the transmission will remain in 1st gear until the technician commands the next gear. For another example, the technician can command a shift solenoid to turn on or off when carrying out an electrical circuit check. The OSC has two modes of operation for transmission: the BENCH MODE and the DRIVE MODE. Each mode/parameter has a unique set of vehicle operating requirements that the technician must meet before being allowed to operate OSC.

NOTE: To operate OSC, the digital transmission range (TR) sensor and the vehicle speed sensor (VSS) must be operational. No diagnostic trouble codes (DTCs) related to the digital TR sensor or the VSS can be present.

- The vehicle requirements MUST BE MET when SENDING the OSC value. Refer to vehicle requirements for each individual test.
- If the vehicle requirements are NOT MET when SENDING the OSC value, an ERROR MESSAGE will appear. When the ERROR MESSAGE is received, OSC is aborted and must be restarted.
- If, after a sent value is substituted, the vehicle requirements are no longer met, the PCM will cancel the OSC value and resume normal operation. No error message will be sent.
- The OSC value [XXX] may be sent anytime to cancel OSC.

Output State Control (OSC) Procedures

- Carry out visual inspection and vehicle preparation as necessary.
- Select "Vehicle and Engine Selection" menu.
- Select appropriate vehicle and engine.
- Select "Diagnostic Data Link."
- Select "Powertrain Control Module."
- Select "Diagnostic Test Mode."
- Select "KOEO On-Demand Self Test and KOER On-Demand Self Tests."
- Carry out test and record DTCs.
- Repair all NON-Transmission DTCs.
- Repair all VSS and digital TR sensor DTCs.
- Make sure that VSS/digital TR sensors are functional.
- Select "Active Command Modes."
- Select "Output State Control."
- Select "Trans Bench Mode" or "Trans Drive Mode."

OSC Transmission Bench Modes

The following Transmission Bench Modes may be used as necessary during diagnostics.

SSA, SSB, SSC, SSD and TCC in BENCH MODE

⚠ CAUTION: The parking brake must be set prior to carrying out this procedure.

The BENCH MODE allows the technician to carry out electrical circuit checks on the following components:

- SSA Activates SS A OFF or ON.
- SSB Activates SS B OFF or ON.
- SSC Activates SS C OFF or ON.

- SSD Activates SS D OFF or ON.
- TCC Activates TCC OFF or ON.

OSC "SSA, SSB, SSC, SSD, TCC" BENCH MODE Operates ONLY when:

- VSS and digital TR sensor are operational.
- No VSS and digital TR sensor DTCs.
- Transmission range selector lever in P or N.
- Key ON.
- Engine OFF.

OSC Command Values

- [OFF] turns solenoid OFF.
- [ON] turns solenoid ON.
- [XXX] cancels OSC value sent.
- [SEND] sends the values to PCM.

BENCH MODE Procedure for SSA, SSB, SSC, SSD and TCC

Follow operating instructions from the NGS menu screen:

- Select "Output State Control."
- Select "Trans - Bench Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters - SSA, SSB, SSC, SSD or TCC."
- Select "ON" to turn solenoid ON.
- Press "SEND" to send command ON.
- Select "OFF" to turn solenoid OFF.
- Press "SEND" to send command OFF.
- Select "XXX" to cancel at any time.
- Press "SEND."

PC A, PC B, PC C in BENCH MODE

⚠ CAUTION: The parking brake must be set prior to carrying out this procedure.

The BENCH MODE is also used to test the functionality of the transmission electronic pressure control. During BENCH MODE, the PCx solenoids can be commanded in increments of 15 psi from zero to 90 psi and 90 to zero psi.

The line pressure tap is used to verify output pressure from PC A or PC B by turning either one off while verifying the output from the other solenoid. The second pressure tap is used to verify the output from the PC C solenoid.

The OSC functions for the parameter PCx allows the technician to choose the following options:

- PCx Activates PCx to selected values.
- [00] sets PCx pressure to 00 psi.
- [15] sets PCx pressure to 15 psi.
- [30] sets PCx pressure to 30 psi.
- [45] sets PCx pressure to 45 psi.
- [60] sets PCx pressure to 60 psi.

- [75] sets PCx pressure to 75 psi.
- [90] sets PCx pressure to 90 psi.

The OSC PCx Bench Mode should ONLY be operated to check PRESSURE FUNCTIONALITY using an installed pressure gauge (300 psi) when:

- VSS and digital TR sensor are operational.
- No VSS and digital TR sensor DTCs.
- Transmission range selector lever in P or N.
- Pressure gauge installed.
- Key ON.
- Engine ON.
- Engine rpm at least 1,500.

The OSC PCx Bench Mode should ONLY be operated to complete PCx SOLENOID CIRCUIT PINPOINT TESTS when:

- VSS and Digital TR Sensor are operational.
- No VSS and Digital TR Sensor DTCs are present.
- Transmission range selector lever is in "P" or "N".
- Key "ON".
- Engine "OFF".

OSC Command Values

- [00] sets PCx pressure to 00 psi.
- [15] sets PCx pressure to 15 psi.
- [30] sets PCx pressure to 30 psi.
- [45] sets PCx pressure to 45 psi.
- [60] sets PCx pressure to 60 psi.
- [75] sets PCx pressure to 75 psi.
- [90] sets PCx pressure to 90 psi.
- [XXX] cancels OSC value sent.
- [SEND] sends the values to PCM.

BENCH MODE Procedure for PCx

Following operating instructions from the NGS menu screen:

- Select "Output State Control."
- Select "Trans Bench Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters PCx."
- Select Value "0 - 90 psi."
- Press "SEND" to send command.
- Select "XXX" to cancel at any time.
- Press "SEND."

OSC Transmission DRIVE MODES

The DRIVE MODE allows control of three transmission parameters. Each mode/parameter has a unique set of vehicle operating requirements that the technician must meet before being allowed to operate OSC. When using the DRIVE MODE, the recommended procedure is to control one parameter at a time.

The DRIVE MODE allows the technician to carry out the following functions on the transmission:

- GEAR allows upshifts or downshifts.
- TCC engages or disengages the torque converter clutch.
- FIRM_SFT commands a higher control pressure during upshift.

The pressure control (PCx) solenoids for this transmission are not directly controlled during DRIVE MODE testing. Pressures may be raised during an upshift via the harsh shift control channel (FIRM_SFT)

GEAR in DRIVE MODE

This OSC function is used to test the transmission shift functions.

The OSC functions for the GEAR parameter allow the technician to choose the following options:

- [1] PCM selects 1st gear.
- [2] PCM selects 2nd gear.
- [3] PCM selects 3rd gear.
- [4] PCM selects 4th gear.
- [5] PCM selects 5th gear.

The OSC GEAR Mode operates ONLY when:

- VSS and digital TR sensor are operational.
- No VSS and digital TR sensor DTCs.
- Engine ON.
- TCC "OFF" (TCC cannot be engaged)
- Transmission range selector lever in D5.
- Vehicle speed is greater than 3 km/h (2 mph).

OSC Command Values

- [1] PCM selects 1st gear.
- [2] PCM selects 2nd gear.
- [3] PCM selects 3rd gear.
- [4] PCM selects 4th gear.
- [5] PCM selects 5th gear.
- [XXX] cancels OSC value sent.
- [SEND] sends the values to PCM.

DRIVE MODE Procedure for GEAR

Follow operating instructions from the NGS menu screen.

- Select "Output State Control."
- Select "Trans DRIVE MODE."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters GEAR."
- Select Value "1-5."
- Press "SEND" to send command.
- Re-Select Value "1-5."
- Press "SEND" to send command.
- Select "XXX" to cancel at any time.

- Press "SEND."

TCC in DRIVE MODE

This OSC function is used to test whether the torque converter clutch is engaging and disengaging correctly.

The OSC functions for the TCC parameter allows the technician to choose the following:

- TCC activates TCC OFF and ON.
- [ON] turns TCC solenoid ON.
- [OFF] turns TCC solenoid OFF.

OSC "TCC OFF" DRIVE MODE operates ONLY when:

- VSS and digital TR sensors are operational.
- No VSS and digital TR sensor DTCs present.
- Engine ON.
- Transmission range selector lever in D5.
- Vehicle speed is greater than 3 km/h (2 mph).

OSC "TCC ON" DRIVE MODE operates ONLY when:

- VSS and digital TR sensors are operational.
- No VSS and digital TR sensor DTCs present.
- Engine ON.
- Transmission range selector lever in D5.
- Vehicle speed is greater than 3 km/h (2 mph).
- Transmission in 2nd gear or higher.
- TFT is between 33-153°C (60-275° F).
- Brake not applied "OFF" below 32 km/h (20 mph).
- Maintain steady speed.

OSC Command Values

- [OFF] turns TCC OFF.
- [ON] turns TCC ON.
- [XXX] cancels OSC value sent.
- [SEND] sends the values to PCM.

Drive Mode Procedures for TCC

Follow operating instructions from the NGS menu screen.

- Select "Output State Control."
- Select "Trans Drive Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters TCC."
- Select "ON" to turn solenoid ON.
- Press "SEND" to send command ON.
- Select "OFF" to turn solenoid OFF.
- Press "SEND" to send command OFF.
- Select "XXX" to cancel at any time.
- Press "SEND."

FIRM_SFT in DRIVE MODE

This OSC function is used to raise pressure during an upshift to determine whether the pressure control system is functioning correctly. Harsher shifts indicate that the pressure control system works at higher pressure. The best test for isolating pressure control system problems is to carry out the PC A, PC B, PC C in BENCH MODE, using a hydraulic pressure gauge.

The OSC functions for the parameter FIRM_SFT allows the technician to choose the following options:

- FIRM_SFT activates the harsh shift channel.
  - ♦ [ON] sets control pressure higher for all upshifts (determined by the PCM)
  - ♦ [OFF] sets control pressure to normal for all upshifts (determined by the PCM)
  - ♦ [XXX] cancel OSC for FIRM_SFT

OSC "FIRM_SFT" DRIVE MODE operates ONLY when:

- VSS and digital TR sensor are operational.
- No VSS and digital TR sensor DTCs.
- Transmission range selector lever in O/D.
- Pressure gauge installed (optional).
- Key ON.
- Engine ON.
- Vehicle speed greater than 3 km/h (2 mph).
- TCC is OFF (TCC is not engaged).

OSC Command Values

- [ON] sets control pressure high for all upshifts (determined by the PCM)
- [OFF] sets control pressure to normal for all upshifts (determined by the PCM)
- [XXX] cancel OSC for FIRM_SFT
- [SEND] sends the values to the PCM

DRIVE MODE Procedure for FIRM_SFT.

Follow operating instructions from the NGS menu screen.

- Select "Output State Control."
- Select "Trans Drive Mode."
- Select "PIDs" to be monitored.
- Monitor all selected PIDs during test.
- Select "Parameters FIRM_SFT.
- Press "SEND" to send command.
- Select "XXX" to cancel at any time.
- Press "SEND."

Using Output State Control (OSC) and Accessing PIDs

To confirm that the OSC value was sent by the NGS and the PCM has accepted the OSC substitution, a corresponding PID for each OSC parameter must be monitored. Additional PIDs should be monitored to help the technician adequately diagnose the transmission.

The following is a list of OSC parameters and their corresponding PIDs:

Corresponding PID	PID Description
BPP	Brake Pedal Position Switch On/Off
PCA	Pressure Control Solenoid A Commanded Pressure
PCB	Pressure Control Solenoid B Commanded Pressure
PCC	Pressure Control Solenoid C Commanded Pressure
FIRMST	Firm Shift Control (FMC) status requested by OSC; 0 = FSC not commanded by OSC, NGS PID output = OFF; 1 = FSC commanded by OSC, NGS PID output = ON
GEAR	Commanded Transmission Gear (use in drive only)
RPS	Pinpoint test for reverse pressure switch; 0 = closed, 1 = open
FFG RPS	Instantaneous Failure Flag for reverse pressure switch; Failure = 1
RPM	Engine Revolutions Per Minute
SSA	Shift solenoid A Commanded ON
SSB	Shift solenoid B Commanded ON
SSC	Shift solenoid C Commanded ON
SSD	Shift solenoid D Commanded ON
TCC	Torque converter commanded duty cycles (%)
TCCRAT	Torque converter speed ratio (RPM and/or TSS)
TFT	Transmission Fluid Temperature (degrees F)
VSS	Vehicle Speed (mph)

To confirm that the OSC substitution occurred, SEND the OSC value and monitor the corresponding PID value. If no ERROR MESSAGE was received and the value of the corresponding PID is the same as the value sent from OSC, the OSC substitution was successful.

Transmission Drive Cycle Test

NOTE: Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

NOTE: The Transmission Drive Cycle Test must be followed exactly. Transmission failure must occur four times consecutively for shift error DTC code to be set, and five times consecutively for continuous torque converter clutch code to set.

NOTE: When carrying out the Transmission Drive Cycle Test, use the Solenoid Operation Chart for correct solenoid operation. Refer to Pinpoint Tests OSC Equipped Vehicles .

After carrying out the Quick Test, use the Transmission Drive Cycle Test for checking continuous codes.

1. Record and then erase Quick Test codes.
2. Warm engine to normal operating temperature.
3. Make sure transmission fluid level is correct.
4. With transmission in D5 position, moderately accelerate from stop to 80 km/h (50 mph). This allows the transmission to shift into fifth gear. Hold speed and throttle open steady for a minimum of 15 seconds.
5. With transmission in fifth gear and maintaining steady speed and throttle opening, lightly apply and release brake to operate stoplamps. Then hold speed and throttle steady for a minimum of five seconds.
6. Brake to a stop and remain stopped for a minimum of 20 seconds.
7. Repeat steps 4 through 6 at least five times.
8. Carry out Quick Test and record continuous DTCs.

After On-Board Diagnostics

NOTE: The vehicle wiring harness, powertrain control module and non-transmission sensors may affect transmission operations. Repair these concerns first.

After the on-board diagnostic procedures are completed, repair all DTCs.

Begin with non-transmission related DTCs, then repair any transmission related DTCs. Refer to the Diagnostic Trouble Code Charts for information on condition and symptoms. This chart will be helpful in referring to the correct manual(s) and aids in diagnosing internal transmission concerns and external non-transmission inputs. The pinpoint tests are used in diagnosing transmission electrical concerns. Make sure that the vehicle wiring harness and the PCM are diagnosed as well. The Powertrain Control/Emissions Diagnosis (PC/ED) manual will aid in diagnosing non-transmission electronic components.

Before Pinpoint Tests

NOTE: Prior to entering pinpoint tests, check the powertrain control module wiring harness for correct connections, bent or broken pins, corrosion, loose wires, correct routing, correct seals and their condition. Check the PCM, sensors and actuators for damage. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.

NOTE: If a concern still exists after electrical diagnosis, refer to Diagnosis By Symptom in this section.

If DTCs appear while carrying out the on-board diagnostics, refer to the Diagnostic Trouble Code Charts for the appropriate repair procedure. Prior to entering pinpoint tests, refer to any TSBs and OASIS messages for transmission concerns.

Diagnostic Trouble Code Charts

Diagnostic Trouble Code Chart

**May also be generated by some other non-electric transmission hardware system.					
*Output circuit check, generated only by electrical symptoms.					
Five Digit DTC	**Com-ponent**	**Description**	**Condition**	**Symptom**	**Action**
P0102, P0103, P1100, P1101	MAF	MAF concerns	MAF system inoperative which may cause a transmission concern.	High/low EPC pressure, incorrect shift schedule. Incorrect torque converter clutch engagement scheduling. Symptoms similar to a TP failure.	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.
P0112	IAT	IAT indicates 125°C (254°F) (grounded)	Voltage drop across IAT exceeds scale set for temperature 125°C (254°F).	Incorrect EPC pressure. Either high or low which will result in harsh or soft shifts.	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.
P0113	IAT	IAT indicates -40°C (-40°F) (open circuit)	Voltage drop across IAT exceeds scale set for temperature -40°C (-40°F).	Incorrect EPC pressure. Either high or low which will result in harsh or soft shifts.	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.
P0114	IAT	IAT out of on-board diagnostic range	IAT temperature higher or lower than expected during KOEO and KOER.	Rerun on-board diagnostic at normal operating temperature.	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.
P1116	ECT	ECT out of on-board diagnostic range	ECT temperature higher or lower than expected during KOEO and KOER.	Rerun on-board diagnostic at normal operating temperature.	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.
P0117	ECT	ECT indicates 125°C (254°F)	Voltage drop across ECT exceeds scale set for temperature 125°C (254°F) (grounded).	Torque converter clutch will always be off, resulting in reduced fuel economy.	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.
P0118	ECT	ECT indicates -40°C (-40°F)	Voltage drop across ECT exceeds scale set for temperature -40°C (-40°F) (open circuit).	Torque converter clutch will always be off, resulting in reduced fuel economy.	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.
P0121, P0122, P0123, P1120,	TP	TP concern	PCM has detected an error. This error may cause a transmission	Harsh engagements, firm shift feel, abnormal shift schedule, torque	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED)

P1121, P1125, P1124			concern.	converter clutch does not engage. Torque converter clutch cycling.	manual.
P0300-P0308, P0320, P0340, P1351-P1364	EI	EI concerns	EI system is inoperative which may cause a transmission concern.	Harsh engagements and shifts, late WOT shifts, no torque converter clutch engagement.	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.
P0503, P0500,	ABS	Insufficient VSS input from ABS through SCP link.	PCM detected a loss of vehicle speed signal through SCP link from ABS.	No transmission symptom. I.P. speedometer may be affected.	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.
P0705	Digital TR sensor	Digital TR circuit failure	Digital TR circuits, indicating an invalid pattern in TR_D. Condition caused by a short to ground or an open in TR4, TR3A, TR2, and or TR1 circuits. This DTC cannot be set by an incorrectly adjusted digital TR sensor.	Increase in control pressure (harsh shifts). Defaults to D5 or invalid position.	Go To Pinpoint Test C .
P0708	Digital TR sensor	Digital TR sensor circuit TR3A open	Digital TR sensor circuit TR3A reading 2.6v - 5.0v (open circuit). This DTC cannot be set by an incorrectly adjusted digital TR sensor.	Increase in PC pressure. Defaults to D5 for all gear positions.	Go To Pinpoint Test C .
P0712	TFT	157°C (315°F) indicated TFT sensor circuit grounded	Voltage drop across TFT sensor exceeds scale set for temperature of 157°C (315°F).	Firm shift feel.	Go To Pinpoint Test B .
P0713	TFT	-40°C (-40°F) indicated TFT sensor circuit open	Voltage drop across TFT sensor exceeds scale set for temperature -40°C (-40°F).	Firm shift feel.	Go To Pinpoint Test B .
P0715	TSS	Insufficient input from turbine shaft speed sensor	PCM detected a loss of TSS signal during operation.	Harsh shifts, harsh torque converter clutch activation, and harsh engagement.	Go To Pinpoint Test E .
P0717	TSS	Turbine shaft speed sensor signal	PCM has detected an intermittent TSS signal.	Harsh shifts, harsh torque converter clutch activation, and harsh	Go To Pinpoint Test E .

		intermittent.		engagement.	
P0718	TSS	Turbine shaft speed sensor signal noisy.	PCM has detected a noisy TSS signal.	Harsh shifts, harsh torque converter clutch activation, and harsh engagement.	Go To Pinpoint Test E .
P0720	OSS	Insufficient input from OSS sensor	PCM detected a loss of OSS signal during operation.	Possible abnormal shift schedule.	Go To Pinpoint Test E .
P0721	OSS	Output shaft speed sensor signal noisy	PCM has detected an erratic OSS signal.	Abnormal shift schedule.	Go To Pinpoint Test E .
P0722	OSS	Output shaft speed sensor signal intermittent	PCM has detected an intermittent OSS signal.	Abnormal shift schedule.	Go To Pinpoint Test E .
P0731**	SSA, SSB, SSC or internal parts	1st gear error	No 1st gear.	Incorrect gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material). Engine rpm could be higher or lower than expected.	REFER to the Solenoid On/Off Charts. Go To Pinpoint Test A .
P0732**	SSA, SSB, SSC or internal parts	2nd gear error	No 2nd gear.	Incorrect gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material). Engine rpm could be higher or lower than expected.	REFER to the Solenoid On/Off Charts. Go To Pinpoint Test A .
P0733**	SSA, SSB, SSC or internal parts	3rd gear error	No 3rd gear.	Incorrect gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material). Engine rpm could be higher or lower than expected.	REFER to the Solenoid On/Off Charts. Go To Pinpoint Test A .
P0734**	SSA, SSB, SSC	4th gear error	No 4th gear.	Incorrect gear selection depending on failure or	REFER to the Solenoid On/Off

	or internal parts			mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material). Engine rpm could be higher or lower than expected.	Charts. Go To Pinpoint Test A .
P0735	SSA, SSB, SSC, SSD or internal parts	5th gear error	No 5th gear.	Incorrect gear selection depending on failure or mode and manual lever position. Shift errors may also be due to other internal transmission concerns (stuck valves, damaged friction material etc.). Engine rpm could be higher or lower than expected.	REFER to the Solenoid On/Off Chart. Go To Pinpoint Test A .
P0741**	TCC	TCC slippage detected	The PCM picked up an excessive amount of TCC slippage during normal vehicle operation.	TCC slippage/erratic or no torque converter clutch operation.	REFER to the Diagnosis by Symptom Index in Diagnosis By Symptom .
P0743*	TCC	TCC solenoid circuit failure during on-board diagnostic	TCC solenoid circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostics.	Short circuit converter clutch always engage. Open circuit torque converter clutch never engages.	Go To Pinpoint Test A .
P0745, P1747**	PCA	PCA solenoid circuit failure, shorted circuit	Voltage through PCA solenoid is checked. An error will be noted if tolerance is exceeded.	Short circuit causes minimum PCA pressure (minimum capacity) and limits engine torque (alternate firm). Slips in gear and third gear incorrect.	Go To Pinpoint Test D .
P0750*	SSA	SSA solenoid circuit failure	SSA circuit failed to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	No fourth or fifth gear (short) or no first gear (open). Will flash MIL.	Go To Pinpoint Test A .
P0753*	SSA	SSA solenoid circuit failure	SSA circuit failed to provide voltage drop across solenoid.	No fourth or fifth gear (short) or no first gear (open). Will flash	Go To Pinpoint Test A .

			Circuit open or shorted or PCM driver failure during on-board diagnostic.	TCIL.	
P0755*	SSB	SSB solenoid circuit failure	SSB circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	No first gear (short) or no third gear (open). Will flash MIL.	Go To Pinpoint Test A .
P0758*	SSB	SSB solenoid circuit failure	SSB circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	No first gear (short) or no third gear (open). Will flash TCIL.	Go To Pinpoint Test A .
P0760*	SSC	SSC solenoid circuit failure	SSC circuit failed to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Incorrect gear selection depending on condition mode and manual lever position. See Solenoid On/Off chart. Will flash MIL.	Go To Pinpoint Test A .
P0763*	SSC	SSC solenoid circuit failure	SSC circuit failed to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during on-board diagnostic.	Incorrect gear selection depending on condition mode and manual lever position. See Solenoid On/Off chart. Will flash TCIL.	Go To Pinpoint Test A .
P0765	SSD	SSD solenoid circuit failure	SSD circuit failed to provide voltage drop across solenoid. Circuit open, shorted or PCM driver circuit failure during on-board diagnostics.	No engine braking in manual gears. Will flash MIL.	Go To Pinpoint Test A .
P0768	SSD	SSD solenoid circuit failure	SSD circuit failed to provide voltage drop across solenoid. Circuit open, shorted or PCM driver circuit failure during on-board diagnostics.	No engine braking in manual gears. Will flash TCIL.	Go To Pinpoint Test A .
P0775, P1789**	PCB	PCB solenoid circuit failure, shorted circuit	Voltage through PCB solenoid is checked. An error will be noted if tolerance is	Short circuit causes minimum PCB pressure (minimum capacity) and limits engine torque	Go To Pinpoint Test D .

			exceeded.	(alternate firm). Zero PCB no second and fifth gear.	
P0779	PCB	PCB solenoid Intermittent short to ground	Voltage through PCB solenoid is checked. An error will be noted if tolerance is exceeded.	Short circuit causes minimum PCB pressure (minimum capacity) and limits engine torque (alternate firm). Zero PCB no second and fifth gear.	Go To Pinpoint Test D .
P0791	ISS	Intermediate shaft speed sensor signal failure.	PCM has detected a loss of the ISS signal.	Harsh shifts (2-3).	Go To Pinpoint Test E .
P0794	ISS	Intermediate shaft speed sensor signal intermittent	PCM has detected an intermittent ISS signal.	Harsh shifts (2-3).	Go To Pinpoint Test E .
P0795, P0797**	PCC	PCC solenoid circuit failure, shorted circuit	Voltage through PCC solenoid is checked. An error will be noted if tolerance is exceeded.	Incorrect gear ratio in fourth and fifth gear.	Go To Pinpoint Test D .
P0796**	PCC	PCC solenoid circuit open	Voltage through PCC solenoid is checked. Error is noted if tolerance is exceeded.	Open circuit causes maximum PCC pressure, harsh engagements and shifts.	Go To Pinpoint Test D .
P0799	PCC	PCC solenoid intermittent short to ground	Voltage through PCC solenoid is checked. An error will be noted if tolerance is exceeded.	Short circuit causes minimum PCC pressure (minimum capacity) and limits engine torque (alternate firm). Incorrect gear ratio in fourth and fifth gear.	Go To Pinpoint Test D .
P0814	J-GATE	J-GATE circuit input signal failed.	PCM has detected incorrect J gate voltage.	No or improper illumination of the J-gate position.	REFER to Section 307-05 .
P0815	SST +/-	SST +/- circuit input signal failed.	PCM has detected an incorrect voltage SST input.	May not be able to shift in manual mode.	REFER to Section 307-05 .
P0840	REV	Reverse pressure switch circuit input signal failed.	PCM has detected incorrect voltage at the reverse pressure switch input.	No engine braking in manual third or fourth gear.	Go To Pinpoint Test G .
P1124	TP	TP voltage high/low for on-board diagnostic.	TP was not in the correct position for on-board diagnostic.	Rerun at appropriate throttle position per application.	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.
P1460	A/C				

		A/C clutch cycling pressure switch error	A/C or defrost ON condition may result from A/C clutch being ON during on-board diagnostic.	DTC set during on-board diagnostic rerun with A/C OFF. Failed ON EPC pressure slightly low with A/C OFF.	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.
P1636	SSx	SSx ISIG communication error	PCM has detected an error with the ISIG chip.		INSTALL a new PCM.
P1700	TRANS	Transmission indeterminate failure	Internal component failure. Direct one-way clutch failure.	Failed a neutral condition. FMEM becomes active engine rpm limited to 4000 rpms. No 1st, 3rd, or 4th gear in automatic mode. Other DTCs that may set P1700: P0745, P1747, P1760, P1714, P1715, P0750, P0755.	If other solenoid DTCs are present, diagnose and repair them first. CLEAR DTCs and drive vehicle. If P1700 returns, disassemble transmission and inspect the direct one-way clutch. Repair as required. CLEAR DTC. Drive vehicle and verify repair.
P1702	Digital TR	Digital TR signal intermittent, code P0705, P0708 are set.	See P0705, P0708 conditions.	See P0705, P0708 symptoms.	Go To Pinpoint Test C .
P1703	BPP	Brake not actuated during on-board diagnostic KOER	Brake not cycled during KOER.	Failed ON or not connected torque converter clutch will not engage at less than 1/3 throttle. Failed OFF or not connected torque converter clutch will not disengage when brake is applied.	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.
P1703	BPP	BPP switch circuit failed	Brake ON circuit failure during KOEO.	Failed ON or not connected torque converter clutch will not engage at less than 1/3 throttle. Failed OFF or not connected torque converter clutch will not disengage when brake is applied.	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.
P1704	Digital TR	Digital TR not in P or N positions during KOEO/KOER.	Digital TR sensor or shift cable incorrectly adjusted or digital TR circuit failure.	Wrong commanded PC pressure. Digital TR reading the wrong gear position. (i.e., in overdrive position, transmission stuck in	Go To Pinpoint Test C .

				manual three for base shifter and four for SST shifter).	
P1705	Digital TR	Digital TR not in PARK or NEUTRAL during KOEO/KOER.	KOEO/KOER not run in PARK or NEUTRAL, or digital TR circuit failure.	DTC is set.	RERUN KOEO/KOER in PARK or NEUTRAL or Go To Pinpoint Test C .
P1711	TFT	TFT out of on-board diagnostic range	Transmission not at operating temperature during on-board diagnostic.	DTC set vehicle cold or overheated.	Warm or cool vehicle to normal operating temperature. Go To Pinpoint Test B .
P1713	TFT	No change in TFT - low range	PCM has detected no TFT change at low range during operation.	Increase EPC, incorrect TCC engagement schedule, harsh engagement, harsh shifts.	Go To Pinpoint Test B .
P1714	SSA	SSA inoperative	Mechanical failure of the solenoid detected.	No fourth or fifth gear (short) or no first gear (open).	Go To Pinpoint Test F .
P1715	SSB	SSB inoperative	Mechanical failure of the solenoid detected.	No first gear (short) or no third gear (open)	Go To Pinpoint Test F .
P1716	SSC	SSC inoperative	Mechanical failure of the solenoid detected.	Incorrect gear selection depending on condition mode and manual lever position. See Solenoid On/Off Chart.	Go To Pinpoint Test F .
P1717	SSD	SSD inoperative	Mechanical failure of the solenoid detected.	Incorrect gear selection depending on condition, mode and manual lever position. See the Solenoid On/Off Chart.	Go To Pinpoint Test F .
P1718	TFT	No change in TFT - high range	PCM has detected no TFT change at high range during operation.	Increase EPC, incorrect TCC engagement schedule, harsh engagement, harsh shifts.	Go To Pinpoint Test B .
P1740	TCC	TCC inoperative	Mechanical failure of the solenoid detected.	Failed ON Converter clutch always on. Failed OFF torque converter never applies.	Go To Pinpoint Test F .
P1746**	PCA	PCA solenoid circuit open	Voltage through PCA solenoid is checked. Error is noted if tolerance is exceeded.	Open circuit causes maximum PCA pressure, harsh engagements and shifts.	Go To Pinpoint Test D .
P1760	PCA				

		PCA solenoid Intermittent short to ground	Voltage through PCA solenoid is checked. An error will be noted if tolerance is exceeded.	Short circuit causes minimum PCA pressure (minimum capacity) and limits engine torque (alternate firm). Slips in gear, third incorrect.	Go To Pinpoint Test D .
P1780	TCS	TCS input incorrect per selected position	TCS voltage incorrect.	No overdrive cancel when range selector is moved	RERUN on-board diagnostic and cycle switch. REFER to Section 307-05 .
P1783	TFT	Transmission overtemp condition indicated	Transmission fluid temperature exceeded 127°C (270°F).	Increase in control pressure.	Go To Pinpoint Test B .
P1788**	PCB	PCB solenoid circuit open	Voltage through PCB solenoid is checked. Error is noted if tolerance is exceeded.	Open circuit causes maximum PCB pressure, harsh engagements and shifts.	Go To Pinpoint Test D .

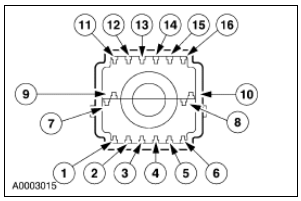
Rotunda Transmission Tester

The Rotunda Transmission Tester is used to diagnose electronically controlled transmissions and is used in conjunction with the pinpoint tests. The tests should be carried out in order. Installing the Rotunda Transmission Tester allows separation of the vehicle electronics from transmission electronics. Refer to the Rotunda Transmission Tester manual for these tests.

- Digital Transmission Range (TR) Sensor Testing
- Resistance/Continuity Test
- Switch Test - Park/Neutral, Backup Lamp, and Optional Circuits

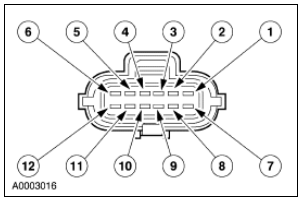
Transmission Connector Layouts

Transmission Vehicle Harness Connector



Pin Number	PTEC-B Pin number	Circuit Function
1	B7	PCA
2	B23	Transmission fluid temperature (TFT) sensor
3		Shift solenoid power
4	B13	PCB
5	B4	SSD
6	B3	SSC
7		NOT USED
8		NOT USED
9		NOT USED
10		NOT USED
11	B12	PCC
12	B17	Signal return
13	B30	Reverse pressure switch
14	B5	Torque converter clutch (TCC) solenoid
15	B2	SSB
16	B1	SSA

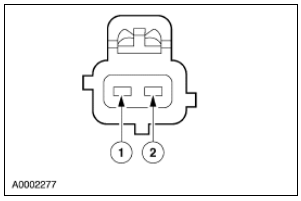
Digital Transmission Range (TR) Sensor Vehicle Harness Connector



Pin Number	PTEC-B Pin Number	Circuit Function
1		NOT USED
2	B17	Signal return
3	B9	TR3A
4	B22	TR1
5	B18	TR2

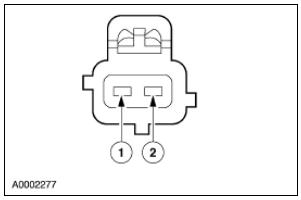
6	B10	TR4
7		Ground
8		Neutral sense
9		Fused power feed
10		Starter control
11		Back up
12		Starter to starter interrupt relay

Turbine Shaft Speed (TSS) Sensor Harness Connector



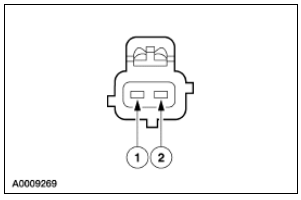
Pin Number	PTEC-B Pin Number	Circuit Function
1	B27	Turbine Shaft Speed Sensor (TSS)
2	B17	Signal Return

Output Shaft Speed (OSS) Sensor Harness Connector



Pin Number	PTEC-B Pin Number	Circuit Function
1	B26	Output shaft speed sensor (OSS)
2	B17	Signal return

Intermediate Shaft Speed (ISS) Sensor Harness Connector



Pin Number	PTEC-B Pin Number	Circuit Function
1	B21	Intermediate shaft speed sensor (ISS)
2	B17	Signal return

Digital Transmission Range (TR) Sensor Diagnosis Chart

Selector Position	Base Shift Lever Indicator	Select Shift Lever Indicator	PID: TR_D				PID: TR_V (volts)
			TR4	TR3A	TR2	TR1	TR3A (PCM pin 64 to sigrtn)
PARK	P	P	0	0	0	0	0.0 Volts
In Between	R	R	0	1	0	0	1.3 - 1.8 Volts
REVERSE	R	R	1	1	0	0	1.3 - 1.8 Volts
In Between	R	R	0	1	0	0	1.3 - 1.8 Volts
NEUTRAL	N	N	0	1	1	0	1.3 - 1.8 Volts
In Between	D5/D4	D5	1	1	1	0	1.3 - 1.8 Volts
OVERDRIVE	D5/D4	D5	1	1	1	1	1.3 - 1.8 Volts
In Between	D5/D4	D5	1	1	1	0	1.3 - 1.8 Volts
Manual 3	3	D4	1	0	1	0	0.0 Volts
In-Between	2		1	0	1	1	0.0 Volts
Manual 2	2		1	0	0	1	0.0 Volts
In Between	2		1	0	1	1	0.0 Volts
Manual 1	Man 1		0	0	1	1	0.0 Volts

A. TR_V is the voltage at the PCM pin 64 (TR3A Circuit) to signal return.
B. "In Between" reading could be caused by a shift cable or digital TR sensor misaligned or a digital TR sensor circuit failure of TR1, TR2, TR3A, or TR4.
C. TR_D: 1= Open digital TR switch, 0= Closed digital TR switch.
D. EEC-V Control System Breakout Box Readings: Taken from PCM signal pins for TR1, TR2, TR3A, TR4 to signal return.
   - **Voltages for TR1, TR2, TR4:**
   - 0 = 0.0 volts.
   - 1 = 9.0 - 14.0 volts.
   - **Voltage for TR3A:**
   - 0 = 0.0 volts.
   - 1 = 1.3 - 1.8 volts.

Wiggle Test Information for Open/Shorts

A. TR4, TR3A, TR2, and TR1 are all closed in PARK, PARK is a good position to check for intermittent open circuits (with scan tool monitoring TR_D).
B. TR4, TR3A, TR2, and TR1 are all open in D5, so D5 is a good position to check for shorts to ground. To determine the shorted components while observing TR_D, unplug the TR and see if the short goes away. If the short is still present unplug the transmission harness and see if the short goes away. If the short is still present, then the short is in the PCM or vehicle harness. Remove the suspect circuit(s) wire terminal from the PCM connector. If the short is still present, then the PCM has an internal failure, otherwise the failure is in the vehicle harness.

Reverse Pressure (RP) Switch Diagnosis Chart

Selector Lever Position	Actual Gear	PID RPS
P,R,N		1
D5	1	0/1 [a]
	2	0/1 [a]
	3	1
	4	1
	5	1
D4	1	0/1 [a]
	2	0/1 [a]
	3	1
	4	1
3	3	1
2	2	0/1 [a]
1	1	0/1 [a]

[a] RPS will read "0" when pressure is above 23 psi and "1" when PC A pressure is below 8 psi. This reading should show "0" for a calibrated time then go to "1".

RP Switch Symptoms

Conditions	Actions	Results
FFG_RPS = 1	RPS does not match RPS diagnosis chart	No manual third gear and fourth gear
FFG = Failure Flag		
P0840 set	RPS reads zero (0) in first, third, fourth, and fifth or one (1) in first, third, fourth, and fifth (PCM sees this condition three times in first)	"E" symbol will appear on the instrument panel. If equipped with the message center, a message to "Check Transmission" will be transmitted. No manual third and fourth gears.

Pinpoint Tests OSC Equipped Vehicles

Special Tool(s)

 ST1565-A	Transmission Fluid Pressure Gauge 307-004 (T57L-77820-A)
 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
	Trans Tester TR/MLP Overlay and Manual 007-00131 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation Star (NGS) Tester 418-F205 or equivalent
 ST1632-A	MLP-TR Cable 418-F107 (007-00111) or equivalent
 ST1389-A	Transmission Tester 307-F016 (007-00130) or equivalent

Shift Solenoid Pre-Diagnosis

Any time an electrical connector or solenoid body is disconnected, inspect the connector for terminal condition, corrosion and contamination. Also inspect the connector seal for damage. Clean, repair or install new as necessary.

Use the following shift solenoid operation information when carrying out Pinpoint Test A.

Solenoid Operation Chart

Base Gearshift Selector Position	Powertrain Control Module (PCM) Commanded Gear	5R55N Solenoid States						
		SSA	SSB	SSC	SSD	PCA	PCB	PCC
P/N	P	On	Off	Off	On	L [1]	C [2]	L
R	R	On	Off	Off	On	L	H [3]	H
D5	1	On	Off	Off	On	C	L	L
	2	On	Off	On	On	L	C	L
	3	On	On	Off	On	C	L	L
	4	Off	Off	Off	On	C	L	H

	5	Off	Off	On	On	C	C	H
D4	1	On	Off	Off	On	C	L	L
	2	On	Off	On	On	L	C	L
	3	On	On	Off	On	C	L	L
	4	Off	Off	Off	Off	C	C	H
3	3	On	On	Off	Off	C	C	L
2	2	On	Off	On	Off	C	C	L
1	1	On	Off	Off	Off	C	C	L

[1] Low line pressure
[2] Control line pressure
[3] High line pressure

Solenoid Operation Chart

Select Shift (optional) Gearshift Selector Position	Powertrain Control Module (PCM) Commanded Gear	5R55N Solenoid States						
		SSA	SSB	SSC	SSD	PCA	PCB	PCC
P/N	P	On	Off	Off	On	L [1]	C [2]	L
R	R	On	Off	Off	On	L	H [3]	H
D5	1	On	Off	Off	On	C	L	L
	2	On	Off	On	On	L	C	L
	3	On	On	Off	On	C	L	L
	4	Off	Off	Off	On	C	L	H
	5	Off	Off	On	On	C	C	H
D4	1	On	Off	Off	On	C	L	L
	2	On	Off	On	On	L	C	L
	3	On	On	Off	On	C	L	L
	4	Off	Off	Off	Off	C	C	H
+/-	1	On	Off	Off	Off	H	H	L
	2	On	Off	On	Off	H	H	L
	3	On	On	Off	Off	H	H	L
	4	Off	Off	Off	Off	H	H	H
	5	Off	Off	On	On	H	H	H

[1] Low line pressure
[2] Control line pressure
[3] High line pressure

Shift Solenoid Failure Mode Chart "Always Off"

Failed OFF due to powertrain control module and/or vehicle wiring concerns, solenoid electrically, mechanically or hydraulically stuck OFF.

SSA Always "OFF":	Transmission Range Selector

	Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear	
1	3	3
2	2	2
3	3	3
4	4	4M [a]
5	5	

[a] Manual

SSB Always "OFF":	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	1	1
2	2	2
3	1	1
4	4	4M [1]
5	5	

[1] Manual

SSC Always "OFF":	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	1	1
2	1	1
3	3	3
4	4	4M [1]
5	4	

[1] Manual

SSD Always "OFF":	Transmission Range Selector Lever Position

	D5	D4
PCM Gear Commanded	**Actual Gear Obtained**	
1	1/1M [1]	1/1M [1]
2	2M [1]	2M [1]
3	3/3M [1]	3M [1]
4	4/4M [1]	4M [1]
5	5	

[1] Manual

Shift Solenoid Failure Mode Chart "Always On"

Failed OFF due to powertrain control module and/or vehicle wiring concerns, solenoid electrically, mechanically or hydraulically stuck ON.

SSA Always "ON":	**Transmission Range Selector Lever Position**	
	D5	**D4**
PCM Gear Commanded	**Actual Gear Obtained**	
1	1	1
2	2	2
3	3	3
4	1	1M [1]
5	2	

[1] Manual

SSB Always "ON":	**Transmission Range Selector Lever Position**	
	D5	**D4**
PCM Gear Commanded	**Actual Gear Obtained**	
1	3	3
2	2	2
3	3	3
4	4	4M [1]
5	5	

[1] Manual

SSC Always "ON":	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	1/2	1/2
2	2	2
3	3/Ratio 1.16	3/Ratio 1.16
4	4/5	4/5
5	5	

SSD Always "ON":	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	1	1
2	2	2
3	3	3
4	4	4
5	5	

Pressure Control Solenoid Failure Mode Chart "Always Low"

PC A "Low":	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	S [2] /1	1
2	2	2
3	S [2] /1	1
4	S [2] /4	4M
5	5	

[2] Slips

PC B "Low":	Transmission Range

	Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	1	1
2	1	1
3	3	3
4	4	4
5	4	

PC C "Low":	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	1	1
2	2	2
3	3	3
4	3	3
5	1.1	

Pressure Control Solenoid Failure Mode Chart "Always High"

PC A "High":	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	Actual Gear Obtained	
1	1	1
2	2	2
3	3	3
4	4	4M [1]
5	5	

[1] Manual

PC B "High":	Transmission

	Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	**Actual Gear Obtained**	
1	1	1
2	2	2
3	3	3
4	4	4M [1]
5	5	

[1] Manual

PC C "High":	Transmission Range Selector Lever Position	
	D5	D4
PCM Gear Commanded	**Actual Gear Obtained**	
1	1	1
2	2	2
3	3	3
4	4	4M [1]
5	5	

[1] Manual

Pinpoint Tests

PINPOINT TEST A: SHIFT AND TORQUE CONVERTER CLUTCH SOLENOIDS

PINPOINT TEST B: TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR

PINPOINT TEST C: DIGITAL TRANSMISSION RANGE (TR) SENSOR

PINPOINT TEST D: PRESSURE CONTROL (PC) SOLENOIDS (PCA, PCB, PCC)

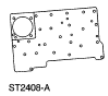
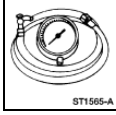
PINPOINT TEST E: TURBINE SHAFT SPEED (TSS), INTERMEDIATE SHAFT SPEED (ISS), AND OUTPUT SHAFT SPEED (OSS) SENSORS

PINPOINT TEST F: SOLENOID MECHANICAL FAILURE

PINPOINT TEST G: REVERSE PRESSURE SWITCH

Special Testing Procedures

Special Tool(s)

 ST2408-A	Air Test Plate, Transmission 307-405
 ST1565-A	Transmission Fluid Pressure Gauge 307-004 (T57L-77820-A)

The special tests are designed to aid the technician in diagnosing the hydraulic and mechanical portion of the transmission.

Engine Idle Speed Check

Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the engine idle speed.

Line Pressure Test

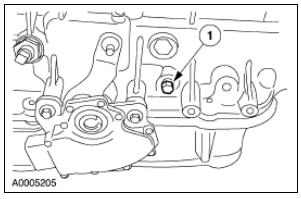
⚠ CAUTION: Carry out Line Pressure Test prior to carrying out Stall Speed Test. If line pressure is low at stall, do not carry out the Stall Speed Test or further transmission damage will occur. Do not maintain wide open throttle in any gear range for more than five seconds.

NOTE: Certain sensor failures may cause high PC, FMEM (Failure Mode Effect Management) actions. Be sure that self test and electrical repairs have been carried out, or test results may be incorrect.

NOTE: The line pressure tap is used to verify output pressure from PC A or PC B by turning either one off while verifying the output from the other solenoid. The second pressure tap is used to verify the output from the PC C solenoid.

This test verifies that the line pressure is within specifications.

1. Connect pressure gauge to the line pressure tap.



Item	Part Number	Description
1		Line Pressure Tap

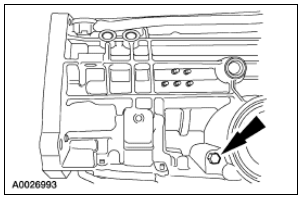
2. Start engine and check line pressures. Refer to the following Line Pressure Chart to determine if line pressure is within specifications.

Line Pressure Chart

Range	Idle	WOT Stall	Idle	WOT Stall
	PC C	PC C	Line	Line
P/N	0-103 kPa (0-15 psi)	0-103 kPa (0-15 psi)	862-1,137 kPa (125-165 psi)	2,000-2,482 kPa (290-360 psi)
R	793 kPa (115 psi)	793 kPa (115 psi)	758-1,034 kPa (110-150 psi)	1,448-1,793 kPa (210-260 psi)
D5/D4	0-103 kPa (0-15 psi)	0-103 kPa (0-15 psi)	758-1,034 kPa (110-150 psi)	1,448-1,793 kPa (210-260 psi)
M5/M4	0-103 kPa (0-15 psi)	0-103 kPa (0-15 psi)	425-800 kPa (76-116 psi)	1,448-1,793 kPa (210-260 psi)
M3	0-103 kPa (0-15 psi)	0-103 kPa (0-15 psi)	758-1,034 kPa (110-150 psi)	1,448-1,793 kPa (210-260 psi)
M2/M1	0-103 kPa (0-15 psi)	0-103 kPa (0-15 psi)	634-910 kPa (92-132 psi)	1,448-1,793 kPa (210-260 psi)
P/N	0-103 kPa (0-15 psi)	0-103 kPa (0-15 psi)	862-1,137 kPa (125-165 psi)	
R	793 kPa (115 psi)	793 kPa (115 psi)	634-910 kPa (92-132 psi)	2,000-2,482 kPa (290-360 psi)
D5/D4	0-103 kPa (0-15 psi)	0-103 kPa (0-15 psi)	758-1,034 kPa (110-150 psi)	1,448-1,793 kPa (210-260 psi)
M5/M4	0-103 kPa (0-15 psi)	0-103 kPa (0-15 psi)	758-1,034 kPa (110-150 psi)	1,448-1,793 kPa (210-260 psi)
M3/M2/M1	0-103 kPa (0-15 psi)	0-103 kPa (0-15 psi)	758-1,034 kPa (110-150 psi)	1,448-1,793 kPa (210-260 psi)

3. If line pressure is not within specifications, check PC C pressure.

4. Connect Pressure Gauge to PC C pressure tap.



Item	Part Number	Description
1		Pressure Control (PC C) Tap

5. Start engine and check PC C pressure. Refer to Line Pressure Diagnosis Chart in this section for specification.

6. If PC C pressure is not within specification, Go To Pinpoint Test D to diagnose PC C operation. If PC C operation is OK, refer to Line Pressure Diagnosis Chart in this section for line pressure concern causes.

Line Pressure Diagnosis Chart

Test Results	Possible Source
High at Idle All Ranges	• Wiring Harnesses • EPC Boost Valve • EPC Solenoid • Main Regulator Valve
Low at Idle All Ranges	• Low Fluid Level • Fluid Inlet Filter/Seal • Main Control Body • Cross Leaks • Gaskets • Pump • Separator Plate
Low All Forward Ranges	• Forward Clutch • Main Control • Overdrive Servo • Intermediate Servo
Low in Park Only	• Valve Body
Low in Reverse Only	• Separator Plate • Rear Servo Piston, Cover Seal • Reverse Clutch • Overdrive Servo • Intermediate Servo • Valve Body • Forward Clutch
Low in Neutral Only	• Valve Body • Overdrive Servo • Intermediate Servo
Low in Overdrive Only	• Forward Clutch • Overdrive Servo • Intermediate Servo • Valve Body
Low in Drive Only (O/D Cancelled)	• Forward Clutch • Overdrive Servo • Intermediate Servo • Valve Body
Low in 1st Position	• Forward Clutch • Valve Body
Low in 2nd Position	• Intermediate Servo • Overdrive Servo • Intermediate Servo • Forward Clutch

Stall Speed Test

This test checks operation of the following items:

- torque converter clutch

- forward clutch
- low-one way clutch (OWC) assembly
- engine performance
- overdrive one-way clutch assembly

⚠ WARNING: Apply the parking brake firmly while carrying out each stall test.

⚠ CAUTION: Always carry out the Line Pressure Test procedures prior to carrying out the Stall Speed Test. If line pressure is low at stall, do not carry out the Stall Speed Test or further transmission damage will occur.

NOTE: The Stall Speed Test should be carried out with the engine and transmission at normal operating temperatures.

1. Connect tachometer to the engine.

2. **⚠ CAUTION: After testing each of the following ranges D5, D4, 3, 2, 1, and R, move the transmission range selector lever to N (NEUTRAL) and run the engine at 1,000 rpm for about 15 seconds to allow the torque converter to cool before testing the next range.**

   ⚠ CAUTION: Do not maintain wide open throttle in any range for more than five (5) seconds.

   ⚠ CAUTION: If the engine rpm recorded by the tachometer exceeds maximum specified rpm, release the accelerator pedal immediately. Clutch or band slippage is indicated.

   NOTE: Prolonged use of this procedure may set Diagnostic Trouble Code P0712, P1783. After Carrying out Stall Speed Test run OBD Test and clear DTCs from memory.

   Press accelerator pedal to floor (WOT) in each range. Record rpm reached in each range. Stall speeds should be as follows:

   Stall Speed Chart

Vehicle	Engine	RPM
Lincoln LS	3.0	2,565-3,060
Lincoln LS	3.9	2,491-2,900

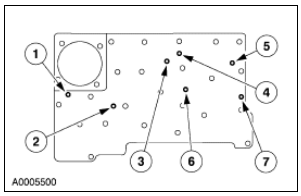
   If stall speeds were too high, refer to the following Stall Speed Diagnosis Chart. If stall speeds were too low, first check the engine idle speed. If engine idle is OK, remove torque converter and check the torque converter one-way clutch for slippage.

   Stall Speed Diagnosis Chart

Transmission Range Selector Lever Position	Stall Speeds High	Stall Speeds Low
D5, D4, and 1	Overdrive One-Way Clutch, Rear One-Way Clutch	
D4, 2 and 1	Forward Clutch, Overdrive One-Way Clutch	
D5	Forward Clutch, Overdrive One-Way Clutch	
D5, D4, 2, 1 and R		

	General Pressure Concerns, Forward Clutch, Overdrive One-Way Clutch	Converter One-Way Clutch or Engine Driveability Concerns
R Only	High/Reverse, High Clutch, Low and Reverse Band/Servo	
2 Only	Intermediate Band/Servo	
1 Only	Low/Reverse Band/Servo	

Air Pressure Tests



Item	Part Number	Description
1		Reverse servo
2	:	Intermediate clutch apply
3		Intermediate servo apply
4		Direct clutch
5		Overdrive servo apply
6		Forward clutch
7		Coast clutch

A no-drive condition can exist even with correct transmission fluid pressure because of inoperative clutches or bands. An erratic shift can be located through a series of checks by substituting air pressure for fluid pressure to determine the location of the failure.

Follow the procedure to determine the location of the inoperative clutch or band by introducing air pressure into the various test plate passages.

NOTE: Use only dry, regulated (276 kPa [40 psi] maximum) air pressure.

Apply air to the appropriate passage(s). A dull thud should be felt or heard or movement could be observed when the component applies. There should be no hissing sound when the component is fully applied.

NOTE: Cover the vent hole in the test plate with a clean, lint-free shop towel to prevent spray when the air is applied. Plugging the vent hole during testing will result in inaccurate results.

1. Drain transmission fluid and remove the transmission fluid pan.

2. Remove the main control valve body.

3. Install the Transmission Test Plate and gasket. Tighten bolts to 10 Nm (89 lb-in).

4. **NOTE:** Do not apply air to the test plate vent hole.

   Apply air to the appropriate clutch port (refer to diagram). A dull thud may be heard or movement felt when the component is applied or released. If clutch seals or check balls are leaking a hissing sound may be heard.

If test results find that the servos do not operate, disassemble, clean and inspect them to locate the source of the concern.

If air pressure applied to the clutch passages fails to operate a clutch, or operates another clutch simultaneously, disassemble and use air pressure to check the fluid passages in the center support and clutches to detect obstructions.

Leakage Inspection

⚠ CAUTION: Do not try to stop the fluid leak by increasing the torque beyond specifications. This may cause damage to the case threads.

Leakage at the transmission fluid pan to case gasket often can be stopped by tightening the attaching bolts to 14 Nm (10 lb-ft). If necessary, install a new oil pan case gasket.

Check the fluid filler plug at the transmission case. If leakage is found here, install a new plug.

Check fluid tubes and fittings between the transmission and the cooler for looseness, wear, or damage. If leakage cannot be stopped by tightening a fluid tube nut, install new parts. When fluid is found leaking between the case and cooler line fitting, check for missing or damaged O-ring seal, then tighten the fitting to maximum specification.

If the leak continues, install a new cooler line fitting and tighten to specification. The same procedure should be followed for fluid leaks between the cooler and the cooler line fittings in this section. For additional information, refer to Section 307-02 .

The cooler can be further checked for leaks. For additional information, refer to Section 307-02 .

If leakage is found at the transmission range selector lever, install a new seal.

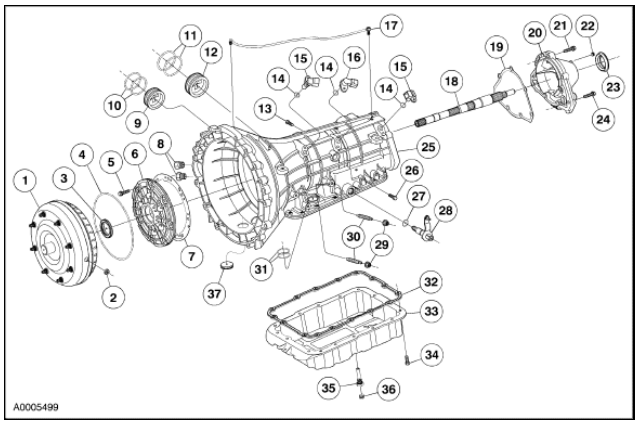
If leakage is found at the transmission harness connector, install a new O-ring seal.

External Sealing

The transmission has the following parts to prevent external fluid leakage:

- gaskets
- lip-type seals
- O-ring seals
- seal rings
- seal grommets
- thread sealant

External Sealing

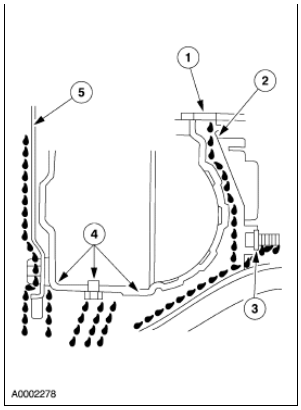


Item	Part Number	Description
1	7902	Torque converter assembly
2	6730	Torque converter drain plug
3	7A248	Front pump fluid seal assembly
4	7A248	Seal front fluid pump
5	W704892-S1300	Screw and washer assembly
6	7G187	Cover assembly fluid pump
7	7A136	Gasket front fluid pump
8	7D273	Fluid tube connector assembly
9	7D027	Overdrive servo cover
10	W703119-S300	Overdrive servo cover seal
11	W702969-S300	Intermediate servo cover seal
12	7D027	Intermediate servo cover
13	390318-S2	Pipe plug
14	W702981-S300	O-ring seal speed sensor
15	7H103	Turbine shaft speed and output shaft speed sensors
16	7M183	Intermediate shaft speed sensor
17	7034	Vent assembly
18	7060	Output shaft
19	7086	Gasket extension housing
20	7A039	Housing assembly extension
22	W500312-S1309	Screw extension housing to case (2 req'd)
22	W701516-S304	Fluid fill access plug
23	7052	Seal assembly extension housing
24	W500311-S1427	Screw extension housing to case (5 Req'd)
25	7005	Case
26	3930318-S2	Pipe plug
27	7B498	Seal assembly main control lever
28	7A256	Manual control lever
29	W705582-S430	Overdrive intermediate lock nut
30	7C492	Screw intermediate band adjuster/lock
31	W705928	Solenoid body connector O-ring seal
32	7A191	Gasket fluid pan
33	7A194	Pan fluid
34	W500213-S1309	Screw fluid pan to case
35	7A010	Fluid fill drain tube
36	W704999-S309	Short hex plug
37	7N171	Converter housing access plug

Fluid Leakage in Torque Converter Area

In diagnosing and correcting fluid leaks in the front pump support and gear and torque converter area, use the following procedures to locate the exact cause of the leakage. Leakage at the front of transmission, as evidenced by fluid around the torque converter housing, may have several sources. By careful observation it is possible, in many instances, to pinpoint the source of leak before removing the transmission from the vehicle. The paths which the fluid takes to reach the bottom of the torque converter housing are shown in the

illustration. The five steps following correspond with the numbers in the illustration.



1. Fluid leaking by the pump seal lip will tend to move along the impeller hub and onto the back of the impeller housing. Except in the case of a total seal failure, fluid leakage by the lip of the seal will be deposited on the inside of the torque converter housing only, near the outside diameter of the housing. Fluid from the vent assembly may move along the impeller hub and onto the back of the impeller housing. Fluid from a converter hub weld leak will move along a path on the inside of the converter housing.

2. Fluid leakage by the outside diameter of the pump seal and pump body will follow the same path that leaks by the inside diameter of the pump seal follow. Fluid from a converter hub weld leak will move along a path on the inside of the converter housing.

3. Fluid that leaks by a pump to case screw or pump gasket will be deposited on the inside of the torque converter housing only. Fluid will not be deposited on the back of the torque converter.

4. Fluid leakage from the converter drain plug, (vehicle-dependent) converter seal weld or converter to flexplate stud weld will appear at the outside diameter of the torque converter on the back face of the flexplate, and in the converter housing only near the flexplate. Fluid leaks from the torque converter will leave a ring of fluid around the inside of the torque converter housing.

5. **NOTE:** White facial tissue paper may aid in determining the color (red is transmission fluid) and source of the leaking fluid.

   Engine oil leaks are sometimes incorrectly diagnosed as transmission pump gasket leaks. The following areas of possible leakage should also be checked to determine if engine oil leakage is causing the concern.

a. Leakage at the valve cover gasket may allow oil to flow over the torque converter housing or seep down between the torque converter housing and cylinder block causing oil to be present in or at the bottom of the torque converter housing.
b. Oil galley plug leaks will allow oil to flow down the rear face of the cylinder block to the bottom of the torque converter housing.
c. Leakage at the crankshaft rear oil seal will work back to the flexplate, and then into the torque converter housing.
d. Leakage at the oil pressure sensor.

Leak Check Test

1. Remove the fluid drain tube and note the color of the fluid. Original factory fill fluid is dyed red to aid in determining if leakage is from the engine or transmission. The red color should assist in pinpointing the leak.

2. Clean off any fluid from the top and bottom of the torque converter housing, of the case, and the rear face of the engine and oil pan. Clean the torque converter area by washing with a suitable nonflammable solvent and blow dry with compressed air.

3. Wash out the torque converter housing, and the front of the flexplate. The torque converter housing may be washed out using cleaning solvent and a squirt-type oil can. Blow all washed areas dry with compressed air.

4. Start and run the engine until the transmission reaches its normal operating temperature. Observe the back of the cylinder block and the top of the torque converter housing for evidence of fluid leakage. Raise the vehicle on a hoist. Refer to Section 100-02 and run the engine at fast idle, then at engine idle, occasionally shifting to the D5 and REVERSE positions to increase pressure within the transmission. Observe the front of the flexplate, back of the cylinder block (in as far as possible), and inside the torque converter housing and front of the case. Run the engine until fluid leakage is evident and the probable source of leakage can be determined.

Leak Check Test With Black Light

Fluid soluble aniline or fluorescent dyes premixed at the rate of 2.5ml (1/2 teaspoon) of dye powder to 0.24L (1/2 pint) of automatic transmission fluid have proven helpful in locating the source of fluid leakage. Such dyes may be used to determine whether an engine fluid or transmission fluid leak is present. An ultraviolet light must be used to detect the fluorescent dye solution.

Transmission Fluid Cooler

⚠ CAUTION: Whenever a transmission has been disassembled to install new parts, the transmission fluid cooler must be replaced and the transmission fluid cooler tubes must be cleaned and backflushed.

NOTE: Cleaning and backflushing the transmission fluid cooling system along with normal cleaning and inspection procedures as outlined in this section during disassembly and reassembly will keep contamination from reentering the transmission and causing a repeat repair.

When internal wear or damage has occurred in the transmission, metal particles, clutch plate material, or band material may have been carried into the torque converter and transmission fluid cooler. These contaminants are a major cause of recurring transmission troubles and must be removed from the system before the transmission is put back in use.

If the vehicle was not equipped with a fluid filter, install a fluid filter kit follow the instructions supplied in the kit. If the vehicle was equipped with a filter install a new filter.

Transmission Fluid Cooler Flow Test

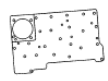
Prior to carrying out the Transmission Fluid Cooler Flow Test check to see if the vehicle is equipped with a fluid filter. If the vehicle was not equipped with a in-line fluid filter, install a fluid filter kit follow the instructions supplied in the kit. If the vehicle was equipped with a filter install a new filter. For additional information, refer to Section 307-02 .

Transmission Fluid Cooler Tube Replacement

Prior to carring out the Transmission Fluid Cooler Tube Replacement check to see if the vehicle is equipped with a in-line fluid filter. If the vehicle was not equipped with a fluid filter, install a fluid filter kit follow the instructions supplied in the kit. If the vehicle was equipped with a filter install a new filter. For additional information, refer to Section 307-02 .

Diagnosis By Symptom

Special Tool(s)

 ST2408-A	Air Test Plate, Transmission 307-405
 ST1137-A	73 III Automotive Meter 105-R0057 or equivalent
	Trans Tester TR/MLP Overlay and Manual 007-00131 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation Star (NGS) Tester 418-F052 or equivalent
 ST1632-A	MLP-TR Cable 418-F107 (007-00111) or equivalent
 ST1389-A	Transmission Tester 307-F016 (007-00130) or equivalent
 ST1565-A	Pressure Gauge, Transmission Fluid 307-004 (T57L-77820-A)
 ST1300-A	UV Leak Detector Kit 164-R0756 or equivalent

The Diagnosis by Symptom Index gives the technician diagnostic information and direction, and suggests possible components, using a symptom as a starting point.

The Diagnosis by Symptom Index is divided into two categories: Electrical Routines (indicated by 200 series numbers) and Hydraulic/Mechanical Routines (indicated by 300 series numbers). The Electrical Routines list the possible electrical components that can cause or contribute to the symptom described. The Hydraulic/Mechanical Routines list the possible hydraulic or mechanical components that can cause or contribute to the symptom described.

Diagnosis by Symptom Index Directions

1. Using the Symptom Index, select the Concern/Symptom that best describes the condition.

2. Refer to the routine indicated in the Diagnosis by Symptom Index.

3. Always begin diagnosis of a symptom with:

a. Preliminary inspections.
b. Verifications of condition.
c. Checking the fluid levels.
d. Carrying out other test procedures as directed.

4. **NOTE:** Not all concerns and conditions with electrical components will set a diagnostic trouble code (DTC). Be aware that the components listed may still be the cause. Verify correct function of these components prior to proceeding to the Hydraulic/Mechanical Routine listed.

   NOTE: When the battery is disconnected or a new battery installed, certain transmission operating parameters can be lost. The powertrain control module (PCM) must relearn these parameters. During this learning process, you may experience slightly firm shifts, delayed, or early shifts. This operation is considered normal and will not affect the function of the transmission. Normal operation will return once these parameters are stored by the PCM.

   Begin with the Electrical Routine, if indicated. Follow the reference or action statements. Always carry out the on-board diagnostic tests as necessary. Never skip steps. Repair as necessary. If the concern is still present after electrical diagnosis, then proceed to the Hydraulic/Mechanical Routine listed.

5. The Hydraulic/Mechanical Routines list possible hydraulic or mechanical components that can cause the concern. These components are listed in the removal sequence and by most probable cause. All components listed must be inspected to ensure correct repair.

Diagnosis by Symptom Index

Diagnosis by Symptom Index

5R55N	Routines	
	Electrical [1]	**Mechanical/ Hydraulic**
Engagement Concerns:		
• No Forward in D5 or D4 Only	201A	301A
• No Forward Only (All Positions)	201B	301B
• No Reverse Only	202	302
• Harsh Reverse Only	203	303
• Harsh Forward Only	204A	304A
• Harsh Manual 1st Gear Only	204B	304B
• Delayed/Soft Reverse Only	205	305
• Delayed/Soft Forward Only	206	306
• No Forward and No Reverse	207	307
• Harsh Forward and Harsh Reverse	208	308

• Delayed Forward and Delayed Reverse	209	309
Shift Concerns:		
• Some/All Shifts Missing (Automatic Mode Only)	210	310
• Timing Concern		
Early/Late (Some/All)	211	311
Erratic/Hunting (Some/All)	212	312
• Feel Concerns		
Soft/Slipping (Some/All)	213	313
Harsh (Some/All)	214	314
• No First Gear in Drive, Engages in a Higher Gear	215	315
• No First Gear in Manual 1st	216	316
• No Manual 2nd Gear	217	317
Torque Converter Clutch Operation Concerns:		
• Does Not Apply	240	340
• Always Applied/Stalls Vehicle	241	341
• Cycling/Shudder/Chatter	242	342
Other Concerns:		
• Shift Lever Efforts High	251	351
• External Leaks	252	352
• Poor Vehicle Performance	253	353
• Noise/Vibration Forward or Reverse	254	354
• Engine Will Not Crank	255	355
• No Park Range	256	356
• Transmission Overheating	257	357
• No Engine Braking in Manual 2nd Position	258	358
• No Engine Braking in Manual 1st Position	259	359
• Fluid Venting or Foaming	261	361

• Vehicle Movement with Gear Selector in "N"	262	362
• Slips/Chatters in Manual 1st Gear	263	363
• Slips/Chatters in Manual 2nd Gear	264	364
• No Engine Braking in Manual 3rd Position	280	380
• No Engine Braking in Manual 4th (D4) Position	281	381
• Slips/Chatters in Manual 3rd Gear	282	382
• Engine Braking in ALL Gears	283	383
• No 2nd and 5th Gears	284	384
• No 3rd, 4th and 5th gears	285	385

[1] Carry out electrical routine first.

Diagnostic Routines

Engagement Concern: No Forward in D5 or D4 Only

Possible Component		Reference/Action
201A ELECTRICAL ROUTINE		
Powertrain Control System		
	· PCM, vehicle wiring harnesses, Pressure Control Solenoid B	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
		· Go To Pinpoint Test D .
		· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
301A HYDRAULIC/MECHANICAL ROUTINE		
Fluid		
	· Incorrect level	· Adjust fluid to the correct level. Refer to Transmission Fluid Level Check in this section.
	· Condition	· Carry out the Fluid Condition Check in this section.
Forward Clutch Assembly		
	· Seals, piston damaged	· Inspect for damage. Repair as necessary.
	· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
	· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
	· Return springs damaged	· Inspect for damage. Repair as necessary.
OD Servo		
	· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.

	· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
OD Band		
	· Band damaged	· Inspect for damage. Repair as necessary.
	· Servo worn or damaged	· Inspect for damage. Repair as necessary.
	· Not adjusted correctly	· Inspect for damage. Repair as necessary.
Case		
	· Damaged	· Inspect for damage. Repair as necessary.

Engagement Concern: No Forward

Possible Component	Reference/Action
201B ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Pressure Control Solenoid B	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test D .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
301B HYDRAULIC/MECHANICAL ROUTINE	
Main Control	
· Bolt not tightened to specification.	· Tighten to specification.
· Separator plate damage.	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install a new main control assembly. If misassembled, assemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Center Support	
· Screw not tightened to specification.	· Tighten to specification.
· Seal rings or bearing damaged	· Inspect for damage. Repair as necessary.
· Outside diameter of case bore damage	· Inspect for damage. Repair as necessary.
· Support damaged or leaking	· Inspect for damage. Repair as necessary.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Forward Planetary Assembly	

· Planetary damage	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Low One-Way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.

Engagement Concern: No Reverse

Possible Component	Reference/Action
202 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Pressure Control Solenoid C (PCC), Shift Solenoid B (SSB)	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A and Go To Pinpoint Test D .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
302 HYDRAULIC/MECHANICAL ROUTINE	
Main Control	
· Bolts not tightened to specifications	· Tighten to specifications.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damage	· If damaged or parts are missing, install a new main control assembly. If misassembled, assemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Direct Clutch Assembly	
· Seals, piston damaged	· Inspect or damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.

· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Reverse Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
Reverse Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
Reverse Drum Assembly	
· One-way clutch damaged	· Inspect for damage. Install a new drum assembly.
· Bearing damaged	· Inspect for damage. Install a new drum assembly.

Engagement Concern: Harsh Reverse ONLY

Possible Component	Reference/Action
203 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Pressure Control Solenoid C (PC C)	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test D .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
303 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test, refer to procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck	· If damaged or parts are missing, install a new main control assembly. If misassembled, assemble correctly. DO NOT stone, file or sand valves. This

or bore damaged	removes the anodized finish and can result in further main control or transmission damage.
Direct Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Reverse Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
Reverse Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
Reverse Drum Assembly	
· One-way clutch damaged	· Inspect for damage. Install a new drum assembly.
· Bearing damaged	· Inspect for damage. Install a new drum assembly.

Engagement Concern: Harsh Forward ONLY

Possible Component	Reference/Action
204A ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Pressure Control Solenoid A (PC A), Pressure Control Solenoid C (PC C)	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test D .

	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
304A HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High Pressures	· Check pressure at line and PC C taps
	· Carry out Line Pressure Test. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck or bore damaged	· If damaged or parts are missing, install a new main control assembly. If misassembled, assemble correctly. DO NOT stone, file or sand valves. This will remove the anodized finish and may result in further main control or transmission damage.
OD Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
OD Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.
Center Support	
· Screw not tightened to specification	· Tighten to specification.
· Seal rings or bearing damage	· Inspect for damage. Repair as necessary.
· Outside diameter of case bore damage	· Inspect for damage. Repair as necessary.
· Support damaged or leaking	· Inspect for damage. Repair as necessary.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.

Engagement Concern: Harsh Manual 1st Gear ONLY

Possible Component	Reference/Action
204B ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Pressure Control Solenoid B (PC B), Turbine Shaft Speed (TSS) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as necessary. Clear DTCs, road test and carry out on-board diagnostic test again.
304B HYDRAULIC/MECHANICAL ROUTINE	
· No hydraulic or mechanical concerns	

Engagement Concern: Delayed or Soft Reverse ONLY

Possible Component	Reference/Action
205 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Pressure Control Solenoid C (PC C)	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test D .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
305 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect pressures	
· Low pressure	· Check pressure at line and PC C taps.
	· Carry out Line Pressure Test, refer to the procedure in this section. Follow pressure diagnosis and repair as necessary.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck or bore damaged	· If damaged or parts are missing, install a new main control assembly. If misassembled, assemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Direct Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
	· Inspect for damage. Repair as necessary.

· Friction elements damaged or worn	
· Return springs damaged	· Inspect for damage. Repair as necessary.
Reverse Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
Reverse Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.

Engagement Concern: Delayed/Soft Forward ONLY

Possible Component	Reference/Action
206 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Pressure Control Solenoid B (PC B)	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test D .
	· Repair as necessary. Clear DTCs, road test and carry out on-board diagnostic test again.
306 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· Low pressures	· Check pressure at line and PC C taps.
	· Carry out Line Pressure Test, refer to procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck or bore damaged	· If damaged or parts are missing, install a new main control assembly. If misassembled, assemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
OD Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
OD Band	
· Band damaged.	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.
Center Support	

· Screw not tightened to specification	· Tighten to specification.
· Seal rings or bearing damaged	· Inspect for damage. Repair as necessary.
· Outside diameter of case bore damage	· Inspect for damage. Repair as necessary.
· Support damaged or leaking	· Inspect for damage. Repair as necessary.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction element damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.

Engagement Concern: No Forward and No Reverse

Possible Component	Reference/Action
207 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Pressure Control Solenoid B (PC B)	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test D .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
307 HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to the correct level. Refer to Transmission Fluid Level Check in this section.
· Condition	· Carry out Fluid Condition Check. Refer to Preliminary Inspection in this section.
Shift Cable/Digital TR Sensor	
· Cable system or digital TR sensor damaged, misaligned	· Inspect and repair as necessary. Refer to Digital Transmission Range (TR) Sensor or Section 307-05 .
Main Control	
· Bolts not tightened to specification	· Tighten bolts to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Input Shaft	
· Damaged	· Inspect for damage. Repair as necessary.

Fluid Pump Assembly	
· Bolts not tightened to specification	· Tighten bolts to specification.
· Gasket damaged	· Inspect for damage. If damaged, install a new gasket.
· Porosity, cross leaks, ball missing, plugged hole	· Inspect for damage. If damaged, repair as necessary.
· Pump gears cracked and/or siezed	· Inspect for damage. Install a new pump.
· Flow control valves, springs, or seal damaged, stuck or not assembled correctly	· Inspect for damage. Install a new seal or flow control valve.
OD Planetary Assembly	
· Planetary damaged	· Inspect for damage. Repair as necessary.
Center Shaft Assembly	
· Damaged. One-way clutch damaged	· Inspect for damage. Repair as necessary.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Forward Planetary Assembly	
· Planetary damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Reverse Planetary Assembly	
· Planetary damaged	· Inspect for damage. Repair as necessary.
Output Shaft	
· Damage	· Inspect for damage. Repair as necessary.
Torque Converter	
· Damaged flexplate or adapter plate	· Inspect for damage. Carry out the Torque Converter checks, refer to the procedure in this section. Repair as necessary.
· Damaged impeller hub	
· Damaged turbine hub	
Direct One-way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.

Engagement Concern: Harsh Forward and Harsh Reverse

Possible Component	Reference/Action
208 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wring harnesses, digital TR sensor, Transmission Fluid (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test B and Go To Pinpoint Test C .
	· Repair as necessary. Clear DTCs, road test and carry out on-board diagnostic test again.
308 HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to the correct level. Refer to Transmission Fluid Level Check
· Condition	· Carry out Fluid Condition Check. Refer to Preliminary Inspection .
Incorrect Pressures	
· High pressures.	· Check line pressure at line and PC C taps.
	· Carry out Line Pressure Test. Refer to procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.

Engagement Concern: Delayed Forward and Delayed Reverse

Possible Component	Reference/Action
209 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Transmission Fluid Temperature (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test B .
	· Repair as necessary. Clear DTCs, road test and carry out on-board diagnostic test again.
309 HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to the correct level. Refer to Transmission Fluid Level Check .
· Condition	· Carry out Fluid Condition Check. Refer to Preliminary Inspection .
Incorrect Pressures	
· High pressures	· Check line pressure at line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install a new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file, or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Fluid Pump Assembly	
· Bolts not tightened to specification	· Tighten to specification.
· Gasket damaged	· Inspect for damage. If damaged, install a new gasket.
· Porosity, cross leaks, ball missing, plugged hole	· Inspect for damage. If damaged, repair as necessary.
· Pump gears cracked and/or siezed	· Inspect for damage. Install a new pump.
· Flow control valves, springs, or seal damaged, stuck or not assembled correctly	· Inspect for damage. Install a new seal or flow control valve.

Shift Concern: Some/All Shifts Missing (Automatic Mode Only)

Possible Component	Reference/Action
210 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoids A, B, C, Torque Converter Clutch (TCC) solenoid, Pressure Control Solenoids A, B, C,	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM, IAT, and

Output Shaft Speed (OSS) sensor, digital TR sensor, IAT sensor, VSS input	VSS.
	· Go To Pinpoint Test A , Go To Pinpoint Test C , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as necessary. Clear DTCs, road test and carry out on-board diagnostic test again.
310 HYDRAULIC/MECHANICAL ROUTINE	
Some Shifts Missing ONLY	
	· If only some shifts are missing, determine which shift(s) is missing.
	· Refer to the following routine(s) for further No Shift concerns: ♦ No 1-2 Shift, Routine 220/320 ♦ No 2-3 Shift, Routine 221/321 ♦ No 3-4 Shift, Routine 222/322 ♦ No 4-5 Shift, Routine 270/370 ♦ No 5-4 Shift, Routine 271/371 ♦ No 4-3 Shift, Routine 223/323 ♦ No 3-2 Shift, Routine 224/324 ♦ No 2-1 Shift, Routine 225/325
Fluid	
· Incorrect level	· Adjust to correct level. Refer to the procedure in this section.
· Condition	· Carry out Fluid Condition Check. Refer to the procedure in this section.
Shift Cable/Digital TR Sensor	
· Cable system or digital TR sensor damaged, misaligned	· Inspect and repair as necessary. Refer to Digital Transmission Range (TR) Sensor or Section 307-05 .
Incorrect Pressures	
· High/Low pressures	· Check pressure at line and PC C taps.
	· Carry out Line Pressure Test. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Fluid Pump Assembly	
· Bolts not tightened to specification	· Tighten to specification.
· Gasket damaged	· If damaged, install a new gasket.
· Porosity, cross leaks, ball missing, plugged hole	· If damaged, repair as necessary.
· Pump gears cracked and/or siezed	· Inspect for damage. Install a new pump.

· Flow control valves, springs, or seal damaged, stuck or not assembled correctly	· Inspect for damage. Install a new seal or flow control valve.
OD Planetary Assembly	
· Planetary damaged	· Inspect for damage. Repair as necessary.
Center Support	
· Screw not tightened to specification	· Tighten to specification.
· Seal rings or bearing damaged	· Inspect for damage. Repair as necessary.
· Outside diameter of case bore damaged	· Inspect for damage. Repair as necessary.
· Support damaged or leaking	· Inspect for damage. Repair as necessary.
Direct Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate One-Way Clutch	
· Worn, damaged, or assembled incorrectly	· Inspect for damage. Repair as necessary.

Shift Concern: Timing Concerns Early/Late

Possible Component	Reference/Action
211 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Output Shaft Speed (OSS) sensor, IAT sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM and IAT.
	· Go To Pinpoint Test E .
	· Repair as necessary. Clear DTCs, road test and carry out on-board diagnostic test again.
311 HYDRAULIC/MECHANICAL ROUTINE	
Only some Shifts Early/Late	
	· If only some shifts are early/late, determine which shift(s) is missing.
	· Refer to the following routine(s) for further No Shift concerns: ♦ Soft/Slipping 1-2 Shift, Routine 226/326 ♦ Soft/Slipping 2-3 Shift, Routine 227/327 ♦ Soft/Slipping 3-4 Shift, Routine 228/328 ♦ Soft/Slipping 4-5 Shift, Routine 272/372

	♦ Soft/Slipping 5-4 Shift, Routine 273/373 ♦ Soft/Slipping 4-3 Shift, Routine 229/329 ♦ Soft/Slipping 3-2 Shift, Routine 230/330 ♦ Soft/Slipping 2-1 Shift, Routine 221/321
Fluid	
· Incorrect level	· Adjust to the correct level. Refer to Transmission Fluid Level Check .
· Condition	· Carry out Fluid Condition Check. Refer to Preliminary Inspection .
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
OD Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
OD Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.

Shift Concern: Timing Concerns Erratic/Hunting (Some/All)

Possible Component	Reference/Action
212 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Output Shaft Speed (OSS) sensor, IAT sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM and IAT.
	· Go To Pinpoint Test E .
	· Repair as necessary. Clear DTCs, road test and carry out on-board diagnostic test again.
312 HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to the correct level. Refer to Transmission Fluid Level Check .
· Condition	· Carry out Fluid Condition Check. Refer to procedure in this section.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.

· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Further Diagnosis	
· For further diagnosis for timing issues, refer to Reference/Actions	· Refer to the following routine(s) for specific diagnosis: • No 1-2 shift see Routine 220/320 • No 2-3 shift see Routine 221/321 • No 3-4 shift see Routine 222/323 • No 4-5 shift see Routine 270/370 • No 5-4 shift see Routine 271/371 • No 4-3 shift see Routine 223/323 • No 3-2 shift see Routine 224/324 • No 2-1 shift see Routine 225/325 • Soft/Slip 1-2 shift see Routine 226/326 • Soft/Slip 2-3 shift see Routine 227/327 • Soft/Slip 3-4 shift see Routine 228/328 • Soft/Slip 4-5 shift see Routine 272/372 • Soft/Slip 5-4 shift see Routine 273/373 • Soft/Slip 4-3 shift see Routine 229/329 • Soft/Slip 3-2 shift see Routine 230/330 • Soft/Slip 2-1 shift see Routine 231/331 • Harsh 1-2 shift see Routine 232/332 • Harsh 2-3 shift see Routine 234/334 • Harsh 3-4 shift see Routine 234/334 • Harsh 4-5 shift see Routine 274/374 • Harsh 5-4 shift see Routine 275/375 • Harsh 4-3 shift see Routine 235/335 • Harsh 3-2 shift see Routine 236/336 • Harsh 2-1 shift see Routine 237/337

Engagement Concern: Feel Soft/Slipping (Some/All)

Possible Component	Reference/Action
213 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoids A, B, C, Pressure Control Solenoids A, B, C, D, Intermediate Shaft Speed (ISS) sensor, Transmission Fluid Temperature (TFT) sensor, IAT Sensor, VSS input	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM, IAT, and VSS.
	· Go To Pinpoint Test A , Go To Pinpoint Test B , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as necessary. Clear DTCs, road test and carry out on-board diagnostic test again.
313 HYDRAULIC/MECHANICAL ROUTINE	
Only some Shifts Soft/Slipping	
	· If only some of the shifts are soft/slipping, determine which shift(s) is missing.

	· Refer to the following routine(s) for further Soft/Slipping concerns: ♦ Soft/Slipping 1-2 Shift, Routine 226/326 ♦ Soft/Slipping 2-3 Shift, Routine 227/327 ♦ Soft/Slipping 3-4 Shift, Routine 228/328 ♦ Soft/Slipping 4-5 Shift, Routine 272/372 ♦ Soft/Slipping 5-4 Shift, Routine 273/373 ♦ Soft/Slipping 4-3 Shift, Routine 229/329 ♦ Soft/Slipping 3-2 Shift, Routine 230/330 ♦ Soft/Slipping 2-1 Shift, Routine 231/331
Fluid	
· Incorrect level	· Adjust to the correct level. Refer to Transmission Fluid Level Check in this section.
· Condition	· Carry out Fluid Condition Check. Refer to the procedure in this section.
Incorrect Pressures	
· High/Low pressures	· Check pressure at line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as necessary.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Fluid Pump Assembly	
· Bolts not tightened to specification	· Tighten to specification.
· Gasket damaged	· Inspect for damage. If damaged, install a new gasket.
· Porosity, cross leaks, misassembled, ball missing, plugged hole	· Inspect for damage. If damaged, repair as necessary.
· Pump gears cracked and/or siezed	· Inspect for damage. Install a new pump.
· Flow control valves, springs, or seal damaged, stuck or not assembled correctly	· Inspect for damage. Install a new seal or flow control valve.
Coast Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Center Support	
· Screw not tightened to specification	· Tighten to specification.
· Seal rings or bearings damaged	· Inspect for damage. Repair as necessary.

· Outside diameter of case bore damage	· Inspect for damage. Repair as necessary.
· Support damaged or leaking	· Inspect for damage. Repair as necessary.
Intermediate Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
Intermediate Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.
Direct Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Reverse Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
Reverse Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
Case	
· Damaged	· Inspect for damage. Repair as necessary.

Shift Concern: Feel Harsh (Some/All)

Possible Component	Reference/Action
214 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoids	· Carry out on-board diagnostic tests. Refer to

A, B, C, Pressure Control Solenoids A, B, C, D, Intermediate Shaft Speed (ISS) sensor, digital TR sensor, Transmission Fluid Temperature (TFT) sensor, IAT sensor, VSS input	thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM, IAT, and VSS.
	· Go To Pinpoint Test A , Go To Pinpoint Test B , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as necessary. Clear DTCs, road test and carry out on-board diagnostic test again.
314 HYDRAULIC/MECHANICAL ROUTINE	
Only some Shifts Harsh	
	· If only some of the shifts are harsh, determine which shift(s) is missing.
	· Refer to the following routine(s) for further No Shift concerns: ♦ Harsh 1-2 Shift, Routine 232/332 ♦ Harsh 2-3 Shift, Routine 233/333 ♦ Harsh 3-4 Shift, Routine 234/334 ♦ Harsh 4-5 Shift, Routine 274/374 ♦ Harsh 5-4 Shift, Routine 275/375 ♦ Harsh 4-3 Shift, Routine 235/335 ♦ Harsh 3-2 Shift, Routine 236/336 ♦ Harsh 2-1 Shift, Routine 237/337
Incorrect Pressures	
· High/Low pressures	· Check pressure at line and PC C taps.
	· Carry out Line Pressure Test, refer to procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Input Shaft	
· Damaged	· Inspect for damage. Repair as necessary.
OD Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
OD Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.
· Anchor pins worn or damaged	· Inspect for damage. Repair as necessary.

Center Shaft Assembly	
· Center shaft assembly damaged	· Inspect for damage. Repair as necessary.
· One-way clutch damaged	· Inspect for damage. Repair as necessary.
Intermediate Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
Intermediate Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seals damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Reverse Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
Reverse Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
Output Shaft	
· Damaged	· Inspect for damage. Repair as necessary.
Case	
· Damaged	· Inspect for damage. Repair as necessary.

Shift Concern: No 1st and 2nd Gear in Drive, Engages in a Higher Gear

Possible Component	Reference/Action
215 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoids A, B, C, digital TR sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A and Go To Pinpoint Test C .

	· Repair as necessary. Clear DTCs, road test and carry out on-board diagnostic test again.
315 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check which pressures are on at Line and PC C taps.
	· Refer to the Band/Clutch Chart in this section to determine which gears are on. Follow the diagnostic routines to repair the missing gears.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file, or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Direct One-way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.
Low One-Way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.

Engagement Concern: No 1st Gear in Manual 1 Position

Possible Component	Reference/Action
216 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoids A, B, Pressure Control Solenoids B, C	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A and Go To Pinpoint Test D .
	· Repair as necessary. Clear DTCs, road test and carry out on-board diagnostic test again.
316 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Carry out Line Pressure Test. Refer to the procedure in this section.

	Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
OD Planetary Assembly	
· Planetary damaged	· Inspect for damage. Repair as necessary.
Direct One-Way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.
Low One-Way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.

Shift Concern: No 2nd Gear in Manual 2 Position

Possible Component	Reference/Action
217 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoids A, B, C, Pressure Control Solenoid B	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A and Go To Pinpoint Test D .
	· Repair as necessary. Clear DTCs, road test and carry out on-board diagnostic test again.
317 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair.
Main Control	
· Bolts not tightened to specification.	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install a new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
OD Servo	

· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
OD Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.
Direct One-Way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.
Low One-Way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.

Torque Converter Operation Concerns: Does Not Apply

Possible Component	Reference/Action
240 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Torque Converter Clutch (TCC) solenoid, Transmission Fluid Temperature (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A and Go To Pinpoint Test B .
	· Repair as necessary. Clear DTCs, road test and carry out on-board diagnostic test again.
340 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Fluid Pump Assembly	
· Bolts not tightened to specification	· Tighten bolts to specification.
· Gasket damaged	· Inspect or damage. If damaged, install a new fluid pump assembly.
· Porosity, cross leaks, ball missing, plugged hole	· Inspect for damage. If damaged, install a new fluid pump assembly.
· Pump gears cracked and/or siezed	· Inspect for damage. Install a new pump.

· Flow control valves, springs, or seal damaged, stuck or not assembled correctly	· Inspect for damage. Install a new seal or flow control valve.
Torque Converter Assembly	
· Torque Converter internal failure preventing engagement, piston application	· Remove transmission. Inspect for damage. Carry out Torque Converter checks. If the torque converter fails to pass the checks or is damaged, install a new or remanufactured torque converter.

Torque Converter Operation Concern: Always Applied/Stalls Vehicle

Possible Component	Reference/Action
241 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Torque Converter Clutch (TCC) solenoid	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A .
	· Repair as necessary. Clear DTCs, road test and carry out on-board diagnostic test again.
341 HYDRAULIC/MECHANICAL ROUTINE	
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valve and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
· Low one-way clutch	· Inspect for damage. Repair as necessary.
Torque Converter Assembly	
· Torque Converter internal failure preventing engagement, piston release	· Remove transmission. Inspect for damage. Carry out Torque Converter checks. If the torque converter fails to pass the checks or is damaged, install a new or remanufactured torque converter.
Low One-Way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.

Torque Converter Operation Concern: Cycling/Shudder/Chatter

Possible Component	Reference/Action
242 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Torque Converter	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of

Clutch (TCC) solenoid	the PCM.
	· Go To Pinpoint Test A .
	· Repair as necessary. Clear DTCs, road test and carry out on-board diagnosis test again.
342 HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Condition contaminated, degraded	· Carry out Fluid Condition Check. Refer to the procedure in this section. If contaminated, locate source of contamination. If burnt, inspect mechanical bands, clutches. Repair as necessary. Change fluid. Carry out drain and refill procedure. Refer to Transmission Fluid Drain and Refill Automated Equipment , Transmission Fluid Drain and Refill Vehicles With Torque Converter Drain Plug or Transmission Fluid Drain and Refill Vehicles Without Torque Converter Drain Plug in this section. Carry out fluid cooler and torque converter cleaning procedure. Refer to Section 307-02 .
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valve and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Torque Converter Assembly	
· Torque converter internal leakage, clutch material damaged	· Remove transmission. Inspect for damage. Carry out torque converter checks, refer to procedures in this section. If torque converter fails to pass the checks or is damaged, install a new or remanufactured converter.

Other Concerns: Shift Lever Efforts High

Possible Component	Reference/Action
251 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, digital TR sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test C .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
351 HYDRAULIC/MECHANICAL ROUTINE	
Shift Cable, Digital TR sensor	
· Cable system or digital TR sensor damaged, misaligned	· Inspect and repair as required. For shift cable information, refer to Section 307-05 . For digital TR information, refer to this section.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.

· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valve and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Case	
· Manual control lever assembly damage, manual valve inner lever pin bent, manual valve inner lever damaged, spring rod damaged	· Inspect for damage. If damaged, install a new part.
· Manual valve lever shaft retaining pin damaged	· Inspect for damage. If damaged, repair as necessary.

Other Concerns: External Leaks

Possible Component	Reference/Action
252 ELECTRICAL ROUTINE	
Powertrain Control System	
· Output Shaft Speed (OSS) sensor, Intermediate Shaft Speed (ISS) sensor, Turbine Shaft Speed (TSS) sensor, digital TR sensor	· Inspect for leakage. If areas around sensor show signs of leakage, install a new sensor O-ring seal. If area behind digital TR sensor shows signs of a leak, a new manual lever shaft seal may need to be installed.
352 HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to correct level. Refer to the procedure in this section.
Case	
· Case vent damaged	· Inspect for damage. If damaged, repair as necessary.
Seals/Gaskets	
· Leakage at gaskets, seals, etc.	· Refer to Leakage Inspection and Fluid Leakage in the Torque Converter Area diagrams in this section for potential leak locations.
	· Remove all traces of lubricant on exposed surfaces of the transmission. Check vent for free breathing. Operate the vehicle at normal temperatures and carry out Leak Check Test procedures in this section. Repair as necessary.

Other Concern: Poor Vehicle Performance

Possible Component	Reference/Action
253 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoids A, B, C, Pressure Control Solenoids A, B, C, Output Shaft Speed (OSS) sensor, Turbine Shaft Speed (TSS) sensor,	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the

Transmission Fluid Temperature (TFT) sensor, digital TR sensor	PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test B , Go To Pinpoint Test C , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
353 HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to correct level. Refer to the procedure in this section.
Input Shaft	
· Damaged	· Inspect for damage. Repair as necessary.
Center Shaft Assembly	
· Center shaft assembly or one-way clutch damaged	· Inspect for damage. Repair as necessary.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Piston check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Torque Converter Assembly	
· Torque Converter one-way clutch slipping	· Carry out torque converter one-way clutch check as listed in this section. If one-way clutch fails the check, install a new or remanufactured torque converter.
· Incorrect torque converter used in rebuild	· Inspect for correct torque converter assembly. If not correct, install the correct torque converter for this application.

Other Concern: Noise/Vibration Forward or Reverse

Possible Component	Reference/Action
254 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Torque Converter Clutch (TCC) solenoid, Pressure Control Solenoids A, B, C	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.

	· Go To Pinpoint Test A and Go To Pinpoint Test D .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
354 HYDRAULIC/MECHANICAL ROUTINE	
Fluid Pump Assembly	
· Bolts not tightened to specification	· Tighten to specification.
· Gasket damaged	· Inspect for damage. If damaged, install a new gasket.
· Porosity, cross leaks, ball missing, plugged hole	· Inspect for damage. If damaged, repair as necessary.
· Pump gears cracked and/or siezed	· Inspect for damage. Install a new pump.
· Flow control valves, springs, or seal damaged, stuck or not assembled correctly	· Inspect for damage. Install a new seal or flow control valve.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Low One-Way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.
Flexplate or Adapter Plate	
· Damaged	· Inspect for damage. Repair as necessary.
· Adapter Plate not aligned correctly	· Remove transmission and using special service tool and procedure in this section, align adapter plate.

Other Concern: Engine Will Not Crank

Possible Component	Reference/Action
255 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, digital TR sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test C .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
355 HYDRAULIC/MECHANICAL ROUTINE	
Shift Cable/ Digital TR Sensor	
· Cable system or digital TR Sensor damaged, misaligned	· Inspect and repair as required. For shift cable information, refer to Section 307-05 . For digital TR information, refer to this section.
Fluid Pump Assembly	
· Seized	· Inspect for damage. If damaged, install a new fluid pump assembly.
Flexplate or Adapter Plate	

	· Damaged	· Inspect for damage. Repair as necessary.

Other Concern: No Park Range

Possible Component	Reference/Action
256 ELECTRICAL ROUTINE	
Powertrain Control System	
· No electrical concerns	
356 HYDRAULIC/MECHANICAL ROUTINE	
Shift Cable/Digital TR sensor	
· Cable system or digital TR sensor damaged, misaligned	· Inspect and repair as required. For shift cable information, refer to Section 307-05 . For digital TR information, refer to this section.
Case	
· Manual control lever assembly damage, manual valve inner lever pin bent, manual valve inner lever damaged, spring rod damaged	· Inspect for damage. If damaged, repair as necessary.
· Manual valve lever shaft retaining pin damaged	· Inspect for damage. If damaged, repair as necessary.
Park System	
· Park gear, parking pawl, parking pawl return spring, park or guide plate, parking actuating rod, parking pawl shaft, manual lever, manual lever detent spring damaged or misassembled	· Inspect for damage. If damaged, repair as necessary.
· External linkages/brackets damaged	· Inspect for damage. If damaged, repair as necessary.

Other Concern: Transmission Overheating

Possible Component		Reference/Action
257 ELECTRICAL ROUTINE		
Powertrain Control System		
	· PCM, vehicle wiring harnesses, Torque Converter Clutch (TCC) solenoid, Pressure Control Solenoids A, B, C, Transmission Fluid Temperature (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
		· Go To Pinpoint Test A , Go To Pinpoint Test B and Go To Pinpoint Test D .
		· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
357 HYDRAULIC/MECHANICAL ROUTINE		
Fluid		
	· Incorrect level	· Adjust to correct level. Refer to the procedure in this section.

Incorrect Pressures		
	· High/low pressures	· Check pressure at line and PC C taps.
		· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control		
	· Bolts not tightened to specification	· Tighten to specification.
	· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
	· Contamination	· Disassemble and clean.
	· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Fluid Pump Assembly		
	· Bolts not tightened to specification	· Tighten to specification.
	· Gasket damaged	· Inspect for damage. If damaged, install a new gasket.
	· Porosity, cross leaks, ball missing, plugged hole	· Inspect for damage. If damaged, repair as necessary.
	· Pump gears cracked and/or siezed	· Inspect for damage. Install a new pump.
	· Flow control valves, springs, or seal damaged, stuck or not assembled correctly	· Inspect for damage. Install a new seal or flow control valve.
Case		
	· Case vent damaged	· Inspect for damage. If damaged, repair as necessary.
Torque Converter Assembly		
	· Sized torque converter one-way clutch	· Remove transmission. Inspect for damage. Carry out torque converter checks. Refer to the procedures in this section. If torque converter fails to pass the checks or is damaged, install a new or remanufactured converter.
	· Excessive slip detected	
Other		
	· Restriction in the transmission cooling system	· Refer to Section 307-02 , Transmission Cooling for information and diagnosis of cooling issues.
	· Excessive trailer tow load	· Refer to owners guide for specifications on trailer towing.
	· Poor engine driveability concerns	· Check engine driveability concerns. Refer to Section 303-08 .

Other Concern: No Engine Braking in Manual 3rd Position

Possible Component	Reference/Action
280 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, shift solenoids A, B, C, Reverse Pressure	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and

(RP) switch, pressure control solenoids A, B	testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test D and Go To Pinpoint Test G .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
380 HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to correct level. Refer to the procedure in this section.
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Fluid Pump Assembly	
· Bolts not tightened to specification	· Tighten to specification.
· Gasket damaged	· Inspect for damage. If damaged, install a new gasket.
· Porosity, cross leaks, ball missing, plugged hole	· Inspect for damage. If damaged, repair as necessary.
· Pump gears cracked and/or siezed	· Inspect for damage. Install a new pump.
· Flow control valves, springs, or seal damaged, stuck or not assembled correctly	· Inspect for damage. Install a new seal or flow control valve.
Coast Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Center Support	
· Screw not tightened to specification	· Tighten to specification.
· Seals rings or bearing damaged	· Inspect for damage. Repair as necessary.
· Outside diameter of case bore damage	· Inspect for damage. Repair as necessary.
· Support damaged or leaking	· Inspect for damage. Repair as necessary.
Intermediate Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
Intermediate Band	

· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Low One-Way Clutch	
· Worn, damaged, or assembled incorrectly	· Inspect for damage. Repair as necessary.

Other Concern: No Engine Braking in Manual 4th (D4) Position

Possible Component	Reference/Action
281 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid D, Reverse Pressure (RP) switch, Pressure Control Solenoid B	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test D and Go To Pinpoint Test G .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
381 HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Improper level	· Adjust to correct level. Refer to the procedure in this section.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Fluid Pump Assembly	
· Bolts not tightened to specification	· Tighten bolts to specification.
· Gasket damaged	· Inspect for damage. If damaged, install a new gasket.
· Porosity, cross leaks, ball missing, plugged hole	· Inspect for damage. If damaged, repair as necessary.
· Pump gears cracked and/or siezed	· Inspect for damage. Install a new pump.

· Flow control valves, springs, or seal damaged, stuck or not assembled correctly	· Inspect for damage. Install a new seal or flow control valve.
Coast Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.

Other Concerns: No Engine Braking in Manual 2nd Position

Possible Component	Reference/Action
258 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoids A, C, D, Pressure Control Solenoid A	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A and Go To Pinpoint Test D .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
358 HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to correct level. Refer to the procedure in this section.
Incorrect Pressures	
· High/low pressures	· Check pressure at line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Reverse Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
Reverse Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.

Other Concern: No Engine Braking in Manual 1st Position

Possible Component	Reference/Action
259 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoids A, C, D, Pressure Control Solenoids A, B	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Carry out Pinpoints Tests A and D.
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
359 HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to correct level. Refer to procedure in this section.
Incorrect pressures	
· High/low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Fluid Pump Assembly	
· Bolts not tightened to specification	· Tighten to specification.
· Gasket damaged	· Inspect for damage. If damaged, install a new gasket.
· Porosity, cross leaks, ball missing, plugged hole	· Inspect for damage. If damaged, repair as necessary.
· Pump gears cracked and/or siezed	· Inspect for damage. Install a new pump.
· Flow control valves, springs, or seal damaged, stuck or not assembled correctly	· Inspect for damage. Install a new seal or flow control valve.
Coast Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Reverse Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
Reverse Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.

Other Concerns: Fluid Venting/Foaming

Possible Component	Reference/Action
261 ELECTRICAL ROUTINE	
Powertrain Control System	
· No Electrical concerns	

361 HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to correct level. Refer to the procedure in this section.
· Condition	· Carry out Fluid Condition Check. Refer to the procedure in this section.
Fluid Pump Assembly	
· Bolts not tightened to specification	· Tighten bolts to specification.
· Gasket damaged	· Inspect for damage. If damaged, install a new gasket.
· Porosity, cross leaks, ball missing, plugged hole	· Inspect for damage. If damaged, repair as necessary.
· Pump gears cracked and/or siezed	· Inspect for damage. Install a new pump.
· Flow control valves, springs, or seal damaged, stuck or not assembled correctly	· Inspect for damage. Install a new seal or flow control valve.
Intermediate Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
Intermediate Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.
Case	
· Case vent damaged	· Inspect for damage. If damaged, repair as necessary.
Other	
· Transmission overheating	· Refer to routine 257/357 in this section.

Other Concern: Vehicle Movement with Gear Selector in "N" Position

Possible Component	Reference/Action
262 ELECTRICAL ROUTINE	
Powertrain Control System	
· No Electrical concerns	
362 HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to correct level. Refer to the procedure in this section.
Incorrect pressures	
· High/low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.

Other Concern: Slips/Chatters in Manual 1st Position

Possible Component	Reference/Action
263 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Pressure Control Solenoids A, B	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test D .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
363 HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to the correct level. Refer to the procedure in this section.
· Condition	· Carry out Fluid Condition Test. Refer to the procedure in this section.
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Fluid Pump Assembly	
· Bolts not tightened to specification	· Tighten bolts to specification.
· Gasket damaged	· Inspect for damage. If damaged, install a new gasket.
· Porosity, cross leaks, ball missing, plugged hole	· Inspect for damage. If damaged, repair as necessary.
· Pump gears cracked and/or siezed	· Inspect for damage. Install a new pump.
· Flow control valves, springs, or seal damaged, stuck or not assembled correctly	· Inspect for damage. Install a new seal or flow control valve.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.

· Return springs damaged	· Inspect for damage. Repair as necessary.
Reverse Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
Reverse Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
Direct One-way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.
Low One-way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.

Other Concern: Slips/Chatters in Manual 2nd Position

Possible Component	Reference/Action
264 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Pressure Control Solenoids A, B	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test D .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
364 HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to the correct level. Refer to the procedure in this section.
· Condition	· Carry out Fluid Condition Check. Refer to the procedure in this section.
Incorrect Pressures	
· High/low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Fluid Pump Assembly	
· Bolts not tightened to specification	· Tighten to specification.
· Gasket damaged	· Inspect for damage. If damaged, install a new gasket.
· Porosity, cross leaks, ball missing, plugged hole	· Inspect for damage. If damaged, repair as necessary.
· Pump gears cracked and/or siezed	· Inspect for damage. Install a new pump.
· Flow control valves, springs, or seal damaged, stuck or not assembled correctly	· Inspect for damage. Install a new seal or flow control valve.
OD Servo	

· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
OD Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.
OD Planetary Assembly	
· Planetary damaged	· Inspect for damage. Repair as necessary.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Reverse Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
Reverse Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
Low One-way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.

Other Concern: Slip/Chatters in Manual 3rd Position

Possible Component	Reference/Action
282 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Pressure Control Solenoids A, B	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test D .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
382 HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to the correct level. Refer to the procedure in this section.
· Condition	· Carry out Fluid Condition Check. Refer to the procedure in this section.
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.

Fluid Pump Assembly	
· Bolts not tightened to specification	· Tighten bolts to specification.
· Gasket damaged	· Inspect for damage. If damaged, install a new gasket.
· Porosity, cross leaks, ball missing, plugged hole	· Inspect for damage. If damaged, repair as necessary.
· Pump gears cracked and/or siezed	· Inspect for damage. Install a new pump.
· Flow control valves, springs, or seal damaged, stuck or not assembled correctly	· Inspect for damage. Install a new seal or flow control valve.
OD Servo	
· Servo retaining ring damaged	· Inspect for damaged. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
OD Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.
Intermediate Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
Intermediate Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Direct One-way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.
Low One-way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.

Other Concern: Engine Braking in ALL Gears

Possible Component	Reference/Action
283 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid D	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
383 HYDRAULIC/MECHANICAL ROUTINE	
No Hydraulic/Mechanical Concerns	

Other Concern: No 2nd and 5th Gears

Possible Component	Reference/Action
284 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Pressure Control Solenoids A, B	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test D .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
384 HYDRAULIC/MECHANICAL ROUTINE	
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.

Other Concern: No 3rd, 4th and 5th Gears

Possible Component	Reference/Action
285 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Pressure Control Solenoids A, B	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test D .

	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
385 HYDRAULIC/MECHANICAL ROUTINE	
Fluid Pump Assembly	
· Bolts not tightened to specification	· Tighten to specification.
· Gasket damaged	· Inspect for damage. If damaged, install a new gasket.
· Porosity, cross leaks, ball missing, plugged hole	· Inspect for damage. If damaged, repair as necessary.
· Pump gears cracked and/or siezed	· Inspect for damage. Install a new pump.
· Flow control valves, springs, or seal damaged, stuck or not assembled correctly	· Inspect for damage. Install a new seal or flow control valve.
OD Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.
OD Planetary Assembly	
· Planetary damaged	· Inspect for damage. Repair as necessary.

Shift Concern: Harsh 1-2 Shift

Possible Component	Reference/Action
232 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Control Solenoid C, Pressure Control Solenoids B, Turbine Shaft Speed (TSS) sensor, Digital TR sensor, Transmission Fluid Temperature (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test B , Go To Pinpoint Test C , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
332 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.

· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
OD Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
OD Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.
Direct Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.

Shift Concern: Harsh 2-3 Shift

Possible Component	Reference/Action
233 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Control Solenoid B, Pressure Control Solenoids A, Turbine Shaft Speed (TSS) sensor, Intermediate Shaft Speed (ISS) sensor, Digital TR sensor, Transmission Fluid Temperature (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test B , Go To Pinpoint Test C , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
333 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in

	this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Direct Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Direct One-way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.

Shift Concern: Harsh 3-4 Shift

Possible Component	Reference/Action
234 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Control Solenoid A, Pressure Control Solenoids C, Digital TR sensor, Transmission Fluid Temperature (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test B , Go To Pinpoint Test C and Go To Pinpoint Test D .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
334 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/low pressures	· Check pressure at Line and PC C taps.

	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as necessary.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Center Support	
· Screws not tightened to specification	· Tighten to specification.
· Seal rings or bearing damaged	· Inspect for damage. Repair as necessary.
· Outside diameter of case bore damage	· Inspect for damage. Repair as necessary.
· Support damaged or leaking	· Inspect for damage. Repair as necessary.
Direct Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.

Shift Concerns: Harsh 4-5 Shift

Possible Component	Reference/Action
274 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid C, Pressure Control Solenoid B, Turbine Shaft Speed (TSS) sensor, Digital TR sensor, Transmission Fluid Temperature (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test B , Go To Pinpoint Test C , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
374 HYDRAULIC/MECHANICAL ROUTINE	

Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
OD Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seal (piston and cover) damaged	· Inspect for damage. Repair as necessary.
OD Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.

Shift Concern: Harsh 5-4 Shift

Possible Component	Reference/Action
275 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Control Solenoid C, Pressure Control Solenoid C, Turbine Shaft Speed (TSS) sensor, Digital TR sensor, Transmission Fluid Temperature (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test B , Go To Pinpoint Test C , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
375 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.

· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Direct Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Direct One-way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.

Shift Concern: Harsh 4-3 Shift

Possible Component	Reference/Action
235 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid A, Pressure Control Solenoid A, Digital TR sensor, Transmission Fluid Temperature (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test B , Go To Pinpoint Test C and Go To Pinpoint Test D .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
335 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Direct Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.

· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.

Shift Concern: Harsh 3-2 Shift

Possible Component	Reference/Action
236 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Control Solenoid C, Pressure Control Solenoid B, Turbine Shaft Speed (TSS) sensor, Intermediate Shaft Speed (ISS) sensor, Digital TR sensor, Transmission Fluid Temperature (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test B , Go To Pinpoint Test C , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
336 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
OD Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
OD Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.

· Not adjusted correctly	· Inspect for damage. Repair as necessary.
Direct Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.

Shift Concern: Harsh 2-1 Shift

Possible Component	Reference/Action
237 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Control Solenoid C, Pressure Control Solenoid B, Turbine Shaft Speed (TSS) sensor, Digital TR sensor, Transmission Fluid Temperature (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test B , Go To Pinpoint Test C , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
337 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.

Direct Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Direct Clutch One-way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.

Shift Concern: No 1-2 Shift

Possible Component	Reference/Action
220 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid C, Pressure Control Solenoid B, Output Shaft Speed (OSS) sensor, Digital TR sensor, IAT sensor, VSS input	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM, IAT and VSS.
	· Go To Pinpoint Test A , Go To Pinpoint Test C , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
320 HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to correct level. Refer to the procedure in this section.
Incorrect Pressures	
· High/Low pressures	· Check pressure at line and PC C taps. Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
OD Servo	

· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
OD Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.
OD Planetary Assembly	
· Planetary damaged	· Inspect for damage. Repair as necessary.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.

Shift Concern: No 2-3 Shift

Possible Component	Reference/Action
221 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid B, Torque Converter Clutch (TCC) solenoid, Pressure Control Solenoid A, Output Shaft Speed (OSS) sensor, Digital TR sensor	· Carry out on-board diagnostic tests. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test C , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
321 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.

· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball, damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball, damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate One-way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.

Shift Concern: No 3-4 Shift

Possible Component	Reference/Action
222 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid A, Pressure Control Solenoid C, Output Shaft Speed (OSS) sensor, Digital TR sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
· Transmission Control Switch (TCS)	· Go To Pinpoint Test A , Go To Pinpoint Test C , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
	· For TSC diagnosis, refer to External Controls in Section 307-05 .
322 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as necessary.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.

· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Center Support	
· Screws not tightened to specification	· Tighten to specification.
· Seal rings or bearing damaged	· Inspect for damage. Repair as necessary.
· Outside diameter of case bore damaged	· Inspect for damage. Repair as necessary.
· Support damaged or leaking	· Inspect for damage. Repair as necessary.
Direct Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.

Shift Concern: No 4-5 Shift

Possible Component	Reference/Action
270 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid C, Pressure Control Solenoid B, Output Shaft Speed (OSS) sensor, Digital TR sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
· Transmission Control Switch (TCS)	· Go To Pinpoint Test A , Go To Pinpoint Test C , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
	· For TSC diagnosis, refer to Section 307-05 .
370 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	

· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
OD Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
OD Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.

Shift Concern: No 5-4 Shift

Possible Component	Reference/Action
271 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid C, Pressure Control Solenoid C, Output Shaft Speed (OSS) sensor, Digital TR sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
· Transmission Control Switch (TCS)	· Go To Pinpoint Test A , Go To Pinpoint Test C , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
	· For TCS diagnosis, refer to Section 307-05 .
371 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can

	result in further main control or transmission damage.
Direct Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.

Shift Concern: No 4-3 Shift

Possible Component	Reference/Action
223 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid A, Pressure Control Solenoid A, Output Shaft Speed (OSS) sensor, Digital TR sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
· Transmission Control Switch (TCS)	· Go To Pinpoint Test A , Go To Pinpoint Test C , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
	· For TCS diagnosis, refer to Section 307-05 .
323 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as necessary.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.

· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.

Shift Concern: No 3-2 Shift

Possible Component	Reference/Action
224 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid C, Pressure Control Solenoid B, Output Shaft Speed (OSS) sensor, Digital TR sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test C , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
324 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as necessary.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
OD Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
OD Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.

· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.

Shift Concern: No 2-1 Shift

Possible Component	Reference/Action
225 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid C, Pressure Control Solenoid B, Output Shaft Speed (OSS) sensor, Digital TR sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test C , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
325 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Forward Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.

Shift Concern: Soft/Slipping 1-2 Shift

Possible Component	Reference/Action
226 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid C, Pressure Control Solenoid B, Transmission Fluid Temperature (TFT) sensor, IAT sensor, VSS input	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test B and Go To Pinpoint Test D .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
326 HYDRAULIC/MECHANICAL ROUTINE	
Fluid	
· Incorrect level	· Adjust to correct level. Refer to the procedure in this section.
· Condition	· Carry out Fluid Condition Check. Refer to the procedure in this section.
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as necessary.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valve and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
OD Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
OD Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.

Shift Concern: Soft/Slipping 2-3 Shift

Possible Component	Reference/Action
227 ELECTRICAL ROUTINE	
Powertrain Control System	

· PCM, vehicle wiring harnesses, Shift Solenoid A, Pressure Control Solenoid A, Intermediate Shaft Speed (ISS) sensor, Transmission Fluid Temperature (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test B , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
327 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Intermediate Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
Intermediate Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Direct One-Way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.

Shift Concern: Soft/Slipping 3-4 Shift

Possible Component	Reference/Action
228 ELECTRICAL ROUTINE	

Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid A, Pressure Control Solenoid C, Transmission Fluid Temperature (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test B and Go To Pinpoint Test E .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
328 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Center Support	
· Screw not tightened to specification	· Tighten to specification.
· Seal rings or bearing damaged	· Inspect for damage. Repair as necessary.
· Outside diameter of case bore damage	· Inspect for damage. Repair as necessary.
· Support damaged or leaking	· Inspect for damage. Repair as necessary.
Direct Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.

Shift Concern: Soft/Slipping 4-5 Shift

Possible Component	Reference/Action
272 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid C, Pressure Control Solenoid B, Transmission Fluid Temperature (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test B and Go To Pinpoint Test D .

	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
372 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
OD Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
OD Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.

Shift Concern: Feel Soft/Slipping 5-4 Shift

Possible Component	Reference/Action
273 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid C, Pressure Control Solenoid C, Transmission Fluid Temperature (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test B and Go To Pinpoint Test D .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
373 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.

· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Direct Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.
· Return springs damaged	· Inspect for damage. Repair as necessary.
Direct One-Way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.

Shift Concern: Feel Soft/Slipping 4-3 Shift

Possible Component	Reference/Action
229 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid A, Pressure Control Solenoid A, Transmission Fluid Temperature (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test B and Go To Pinpoint Test D .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
329 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
Intermediate Clutch Assembly	
· Seals, piston damaged	· Inspect for damage. Repair as necessary.
· Check ball damaged, missing, not seating, off location	· Inspect for mislocation, poor seating, damage. Install a new cylinder.
· Feed tube or seal damaged	· Inspect for damage. Install a new feed tube.
· Friction elements damaged or worn	· Inspect for damage. Repair as necessary.

· Return springs damaged	· Inspect for damage. Repair as necessary.

Shift Concern: Soft/Slipping 3-2 Shift

Possible Component	Reference/Action
230 ELECTRICAL ROUTINE	
Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid C, Pressure Control Solenoid B, Intermediate Shaft Speed (ISS) sensor, Transmission Fluid Temperature (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test B , Go To Pinpoint Test D and Go To Pinpoint Test E .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
330 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.
OD Servo	
· Servo retaining ring damaged	· Inspect for damage. Repair as necessary.
· Seals (piston and cover) damaged	· Inspect for damage. Repair as necessary.
OD Band	
· Band damaged	· Inspect for damage. Repair as necessary.
· Servo worn or damaged	· Inspect for damage. Repair as necessary.
· Not adjusted correctly	· Inspect for damage. Repair as necessary.
Direct One-Way Clutch	
· Worn, damaged or assembled incorrectly	· Inspect for damage. Repair as necessary.

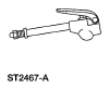
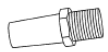
Shift Concern: Feel Soft/Slipping 2-1 Shift

Possible Component	Reference/Action
231 ELECTRICAL ROUTINE	

Powertrain Control System	
· PCM, vehicle wiring harnesses, Shift Solenoid C, Pressure Control Solenoid B, Transmission Fluid Temperature (TFT) sensor	· Carry out on-board diagnostic tests. Refer to thePowertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the PCM.
	· Go To Pinpoint Test A , Go To Pinpoint Test B and Go To Pinpoint Test D .
	· Repair as required. Clear DTCs, road test and carry out on-board diagnostic test again.
331 HYDRAULIC/MECHANICAL ROUTINE	
Incorrect Pressures	
· High/Low pressures	· Check pressure at Line and PC C taps.
	· Carry out Line Pressure Test. Refer to the procedure in this section. Follow pressure diagnosis and repair as required.
Main Control	
· Bolts not tightened to specification	· Tighten to specification.
· Separator plate damaged	· Inspect for damage. If damaged, install a new separator plate.
· Contamination	· Disassemble and clean.
· Valves and springs damaged, misassembled, missing, stuck, or bore damaged	· If damaged or parts are missing, install new main control assembly. If misassembled, reassemble correctly. DO NOT stone, file or sand valves. This removes the anodized finish and can result in further main control or transmission damage.

Transmission Fluid Level Check

Special Tool(s)

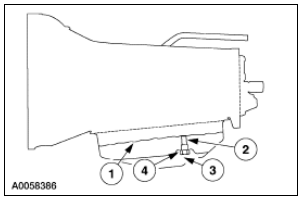
 ST2467-A	Rubber Tip Air Nozzle 100-D009 (D93L-7000-A)
 ST1269-A	Vacuum Pump Kit 416-D002 (D95L-7559-A)
 ST2715-A	Fluid Transporter / Evacuator / Injector 307-D465
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation Star (NGS) Tester 418-F205 or equivalent scan tool
 ST2581-A	Adapter, Fluid Level and Fill Plug 307-437

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM	MERCON® V

Fluid Fill Reference

NOTE: Left side of case is shown.



Item	Part Number	Description
1		Fluid level
2	7A010	Fluid level tube
3	W704999-S309	Fluid level and fill plug (small) (in-vehicle)
4	7A010	Fluid drain plug (large)

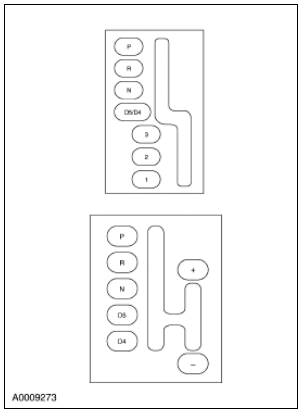
1. Using the scan tool (WDS), monitor the transmission fluid temperature (TFT) using PID: TFT.

2. Start the vehicle.

3. **NOTE:** Engine idle speed is approximately 650 rpm.

   While proceeding with this procedure, run the engine until the transmission fluid temperature is between 27°C - 49°C (80°F - 120°F).

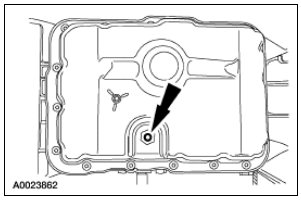
4. Move the range selector lever slowly through each gear, stopping in each position and allowing the transmission to engage.



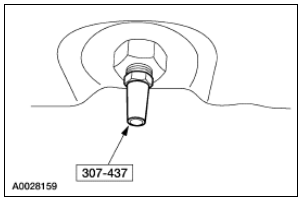
5. Place the range selector lever in the PARK position.

6. With the engine running, position the vehicle on a hoist and set it as close to level as possible. For additional information, refer to Section 100-02 .

7. Hold the larger drain plug with a wrench and remove the small (center) fluid level indicating plug using a 3/16-inch Allen key.

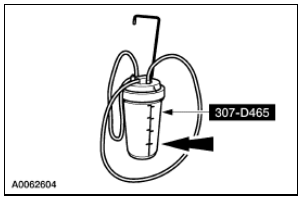


8. Install the special tool into the pan.

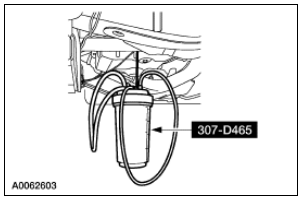


9. **NOTE:** Prior to filling the special tool with clean transmission fluid, make sure that the canister is clean.

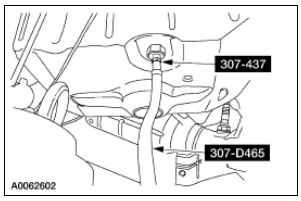
   Fill the special tool with clean automatic transmission fluid.



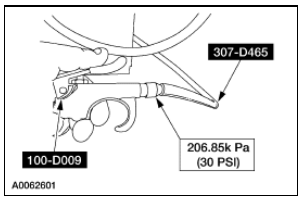
10. Hang the special tool under the vehicle. Position it upright and close to the transmission.



11. Connect the special tools.
    - Connect the open end of the fluid hose from the Fluid Transporter/Evacuator/Injector to the Fluid Level and Fill Plug Adapter at the bottom of the transmission fluid pan.



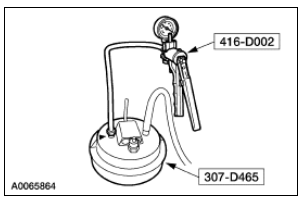
12. Apply a maximum of 206.85 kPa (30 psi) to the open end of the vacuum/pressure hose from the special tool. Fluid will immediately start flowing out of the special tool into the transmission fluid pan.



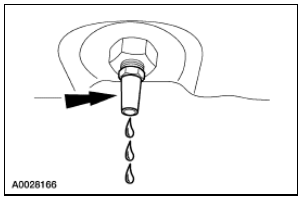
13. Add one pint of transmission fluid into the fluid pan. Stop the process by releasing the air pressure and removing the air nozzle from the end of the hose.

14. Inspect the fluid level in the special tool. If the fluid drains back into the canister, the transmission is full. If no fluid drains back, more fluid will need to be added. Repeat steps 12 and 13.

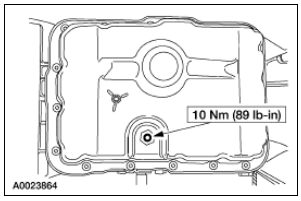
15. Once the transmission is full, place a hand vacuum pump on the open end of the vacuum/pressure hose of the special tool and apply vacuum to the system. This will pull out any extra fluid trapped in the system and direct it into the container.



16. Allow the fluid to drain. Make sure that the fluid temperature is between 27°C - 49°C (80°F - 120°F). When the fluid comes out as a thin stream or drip, the fluid is at the correct level.



17. Reinstall the small (center) fluid level indicating plug using a 3/16-inch Allen key.



18. Check the operation of the transmission by moving the range selector lever slowly through each gear, stopping in each position and allowing the transmission to engage.

Transmission Fluid Cooler Backflushing and Cleaning

For additional information, refer to Section 307-02 .

Transmission Fluid Drain and Refill Automated Equipment

Special Tool(s)

 ST2654-A	Automatic Transmission Flush and Fill Machine 211-00018

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM	MERCON®V

Draining

⚠ CAUTION: Use only clean automatic transmission fluid. Do not use any supplemental transmission fluid additives, treatments or cleaning agents. The use of these materials can affect the operation of the transmission, resulting in internal component failure.

⚠ CAUTION: Always refer to the instructions supplied with the flush and fill machine.

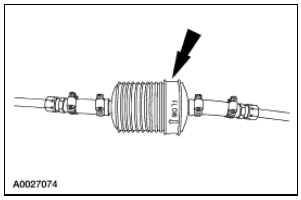
NOTE: This is a new procedure for draining and adding transmission fluid using a suitable transmission flush and fill machine.

1. Position the vehicle on a hoist. Place in PARK. For additional information, refer to Section 100-02 .
2. Use a suitable flush and fill machine to change the fluid.
3. When connecting the flush and fill machine, connect the machine to the fluid cooler tube after the fluid cooler on the cooler return tube. This will help remove any foreign material trapped in the fluid coolers.
4. Carry out the fluid exchange process.

Refill

1. Use only clean automatic transmission fluid.
2. Once the fluid exchange has been completed, disconnect the flush and fill machine. Reconnect any disconnected fluid cooler tubes.
3. **NOTE:** If the vehicle is equipped with an in-line fluid filter, install a new in-line fluid filter (XC3Z-7B155-BA).

   Install a new in-line transmission fluid filter.



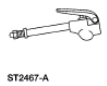
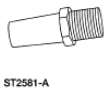
4. Lower the vehicle. For additional information, refer to Section 100-02 .

5. With the engine running and the transmission at normal operating temperature 66-77°C (150-170°F), check and adjust the transmission fluid level and check for any leaks. If fluid is needed, add fluid in increments of 0.24 liter (0.5 pint) until the correct level is achieved (fluid should be in the cross-hatched area of the fluid level indicator).

6. Carry out the fluid level check. For additional information, refer to Transmission Fluid Level Check in this section.

Transmission Fluid Drain and Refill Vehicles With Torque Converter Drain Plug

Special Tool(s)

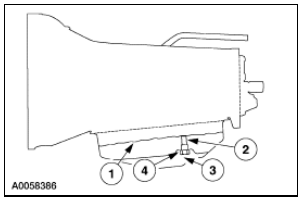
 ST2467-A	Rubber Tip Air Nozzle 100-D009 (D93L-7000-A)
 ST1269-A	Vacuum Pump Kit 416-D002 (D95L-7559-A)
 ST2715-A	Fluid Transporter / Evacuator / Injector 307-D465
 ST2581-A	Adapter, Fluid Level and Fill Plug 307-437

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM	MERCON® V

Fluid Fill Reference

NOTE: Left side of case is shown.

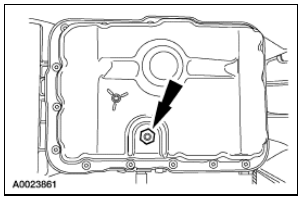


Item	Part Number	Description
1		Fluid level
2	7A010	Fluid level tube
3	W704999-S309	Fluid level and fill plug (small) (in-vehicle)
4	7A010	Fluid drain plug (large)

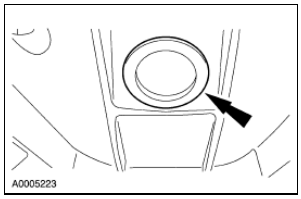
Draining

1. With the vehicle in PARK, position it on a hoist. Set the vehicle as close to level as possible. For additional information, refer to Section 100-02 .

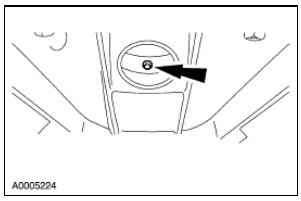
2. Remove the drain plug (large plug) and allow the fluid to drain.



3. Remove the converter housing plug.

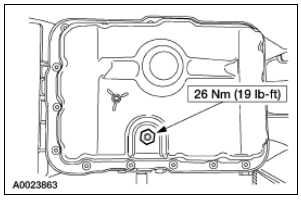


4. Remove and discard the drain plug.

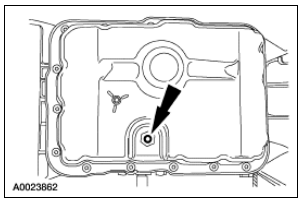


Refill

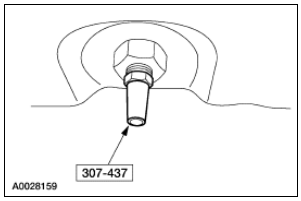
1. Install the fluid drain plug.



2. Hold the larger drain plug with a wrench and remove the small (center) fluid level indicating plug using a 3/16-inch Allen key.

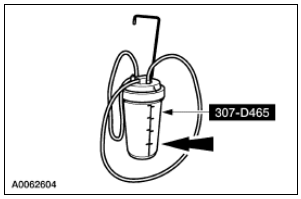


3. Install the special tool into the pan.

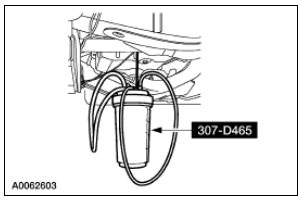


4. **NOTE:** Prior to filling the special tool with clean transmission fluid, make sure that the canister is clean.

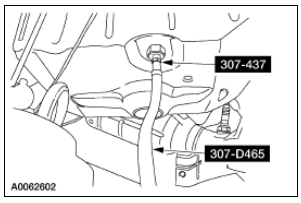
Fill the special tool with clean automatic transmission fluid.



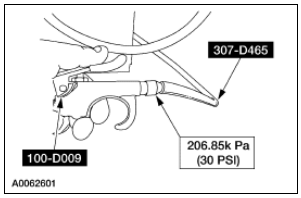
5. Hang the special tool under the vehicle, upright and close to the transmission.



6. Connect the special tools.
    - Connect the open end of the fluid hose from the Fluid Transporter/Evacuator/Injector to the Fluid Level and Fill Plug Adapter at the bottom of the transmission fluid pan.

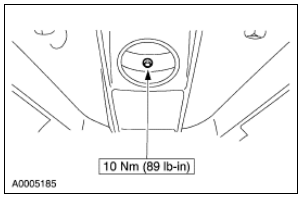


7. Apply a maximum of 206.85 kPa (30 psi) to the open end of the vacuum/pressure hose from the special tool. Fluid will immediately start flowing out of the special tool into the transmission fluid pan.

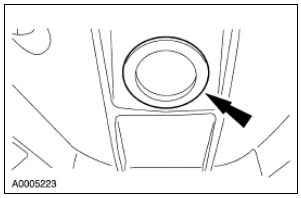


8. Add two or three quarts of transmission fluid into the fluid pan. Stop the process by releasing the air pressure and removing the air nozzle from the end of the hose.

9. Install a new torque converter drain plug to prevent any leakage.



10. Install the converter housing access plug.

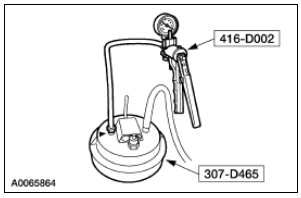


11. **NOTE:** Engine idle speed is approximately 650 rpm.

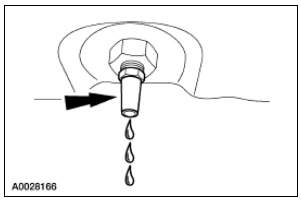
    Start and run the engine until the transmission fluid temperature is between 27°C - 49°C (80°F - 120°F).

12. Inspect the fluid level in the special tool. If the fluid drains back into the canister, the transmission is full. If no fluid drains back, more fluid will need to be added. Repeat steps 11 and 12.

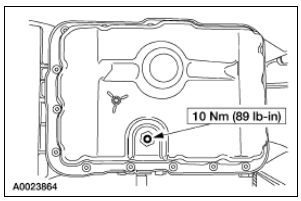
13. Once the transmission is full, place a hand vacuum pump on the open end of the hose of the special tool and apply vacuum to the system. This will pull any extra fluid trapped in the system and direct it into the container.



14. Allow the fluid to drain. When the fluid comes out as a thin stream or drip, the fluid is at the correct level.

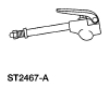
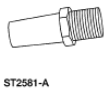


15. Reinstall the small (center) fluid level indicating plug using a 3/16-inch Allen key.



Transmission Fluid Drain and Refill Vehicles Without Torque Converter Drain Plug

Special Tool(s)

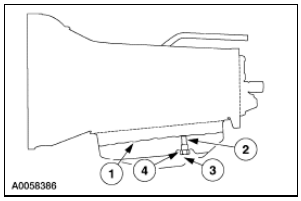
 ST2467-A	Rubber Tip Air Nozzle 100-D009 (D93L-7000-A)
 ST1269-A	Vacuum Pump Kit 416-D002 (D95L-7559-A)
 ST2715-A	Fluid Transporter / Evacuator / Injector 307-D465
 ST2581-A	Adapter, Fluid Level and Fill Plug 307-437

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM	MERCON® V

Fluid Fill Reference

NOTE: Left side of case is shown.

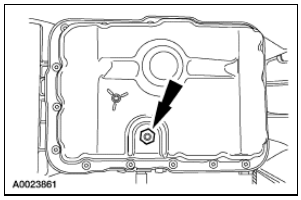


Item	Part Number	Description
1		Fluid level
2	7A010	Fluid level tube
3	W704999-S309	Fluid level and fill plug (small) (in-vehicle)
4	7A010	Fluid drain plug (large)

Draining

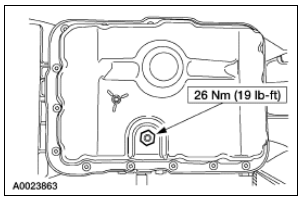
1. With the vehicle in PARK, position it on a hoist. Set the vehicle as close to level as possible. For additional information, refer to Section 100-02 .

2. Remove the drain plug (large plug) and allow the fluid to drain.

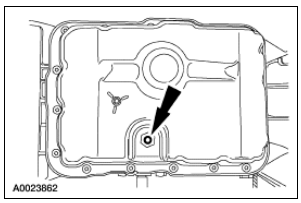


Refill

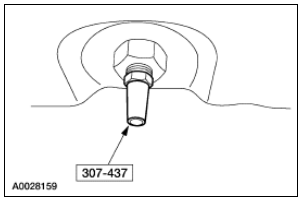
1. Install the fluid drain plug.



2. Hold the larger drain plug with a wrench and remove the small (center) fluid level indicating plug using a 3/16-inch Allen key.

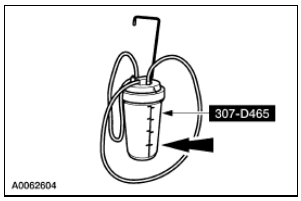


3. Install the special tool into the pan.

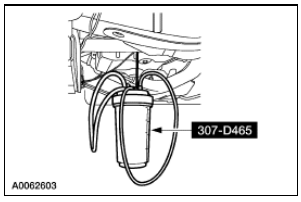


4. **NOTE:** Prior to filling the special tool with clean transmission fluid, make sure that the canister is clean.

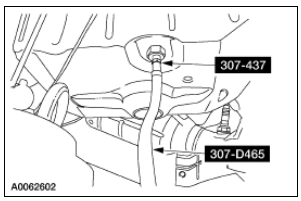
   Fill the special tool with clean automatic transmission fluid.



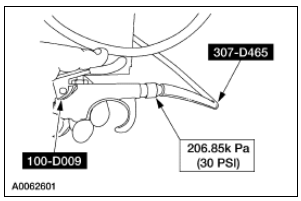
5. Hang the special tool under the vehicle, upright and close to the transmission.



6. Connect the special tools.
    - Connect the open end of the fluid hose from the Fluid Transporter/Evacuator/Injector to the Fluid Level and Fill Plug Adapter at the bottom of the transmission fluid pan.



7. Apply a maximum of 206.85 kPa (30 psi) to the open end of the vacuum/pressure hose from the special tool. Fluid will immediately start flowing out of the special tool into the transmission fluid pan.



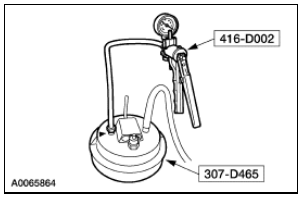
8. Add two or three quarts of transmission fluid into the fluid pan. Stop the process by releasing the air pressure and removing the air nozzle from the end of the hose.

9. **NOTE:** Engine idle speed is approximately 650 rpm.

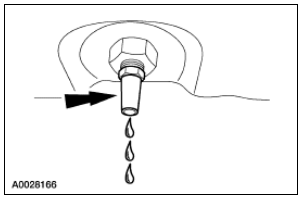
   Start and run the engine until the transmission fluid temperature is between 27°C - 49°C (80°F - 120°F).

10. Inspect the fluid level in the special tool. If the fluid drains back into the canister, the transmission is full. If no fluid drains back, more fluid will need to be added. Repeat steps 9 and 10.

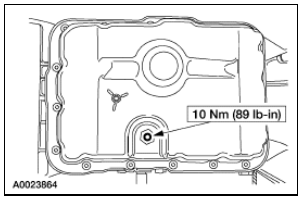
11. Once the transmission is full, place a hand vacuum pump on the open end of the hose of the special tool and apply vacuum to the system. This will pull any extra fluid trapped in the system and direct it into the container.



12. Allow the fluid to drain. When the fluid comes out as a thin stream or drip, the fluid is at the correct level.

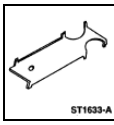


13. Reinstall the small (center) fluid level indicating plug using a 3/16-inch Allen key.


10 Nm (89 lb-in)
A0023864

Transmission Range (TR) Sensor Adjustment

Special Tool(s)

 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)

Material

Item	Specification
Threadlock 262 E2FZ-19554-B	WSK-M2G351-A6

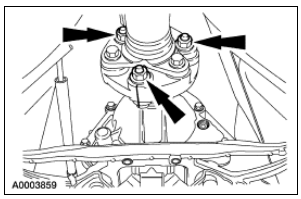
1. Position the vehicle on a hoist. Place in NEUTRAL. For additional information, refer to Section 100-02 .

2. Remove the exhaust heat shield. For additional information, refer to Section 309-00 .

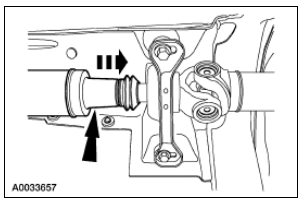
3. **⚠ CAUTION: Index-mark (color paint) the bolts, washers, nuts, and the flex coupling to the transmission flange and the pinion flange to assure assembly in the exact location from which they were removed. Components not assembled in their original locations can cause driveshaft imbalance.**

   ⚠ CAUTION: Do not remove the bolts retaining the flex coupling to the driveshaft.

   Index-mark the front driveshaft pinion flange. Remove the three nuts, washers and bolts.



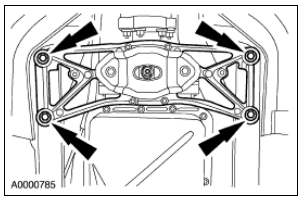
4. Slide the front shaft assembly rearward and support.



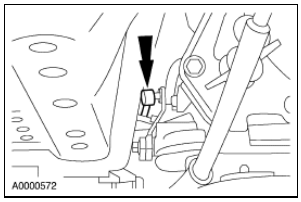
5. **⚠ WARNING: Secure the transmission to the transmission jack with a safety chain. Failure to follow these instructions can result in personal injury.**

   Support the transmission with a transmission jack.

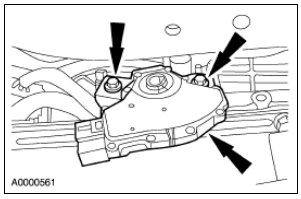
6. Remove the transmission mount and lower the transmission enough to gain access to the digital TR sensor.



7. Disconnect the shift cable.



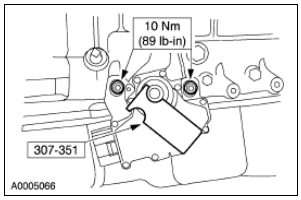
8. Loosen the digital TR sensor screws.



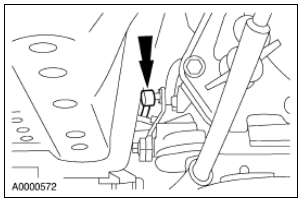
9. ⚠ **CAUTION: Tightening one screw before tightening the other can cause the sensor to bind or become damaged.**

   NOTE: The manual lever must be in the NEUTRAL position.

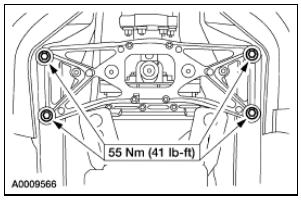
   Using the special tool, align the digital TR sensor and tighten the screws in an alternating sequence.



10. Connect the shift cable.

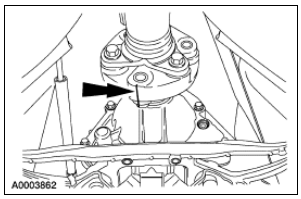


11. Install the rear transmission support and remove the transmission jack.



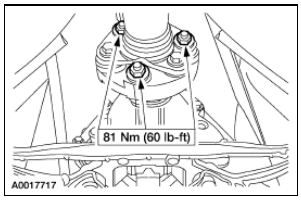
12. ⚠ **CAUTION: Align the index marks or driveshaft imbalance can occur.**

    Align the index marks made during removal and position the driveshaft on the transmission flange.



13. ⚠ **CAUTION: Install the bolts, washers and nuts in their original positions or driveshaft imbalance can occur. Install the driveshaft flex coupling bolts with the head of the bolt seated against the flange, and the nuts seated against the flex coupling.**

    Install the bolts, washers and nuts. Coat the nut and bolt threads with threadlock sealer.



14. Install the exhaust heat shield. For additional information, refer to Section 309-00 .

15. Lower the vehicle.

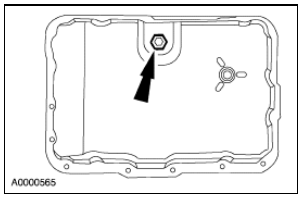
Fluid Pan, Gasket and Filter

Material

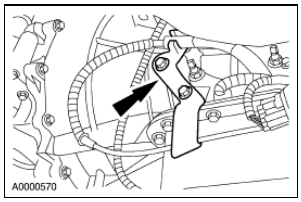
Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

Removal

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Place a drain pan under the transmission fluid pan.
3. Remove the drain plug and drain the fluid.

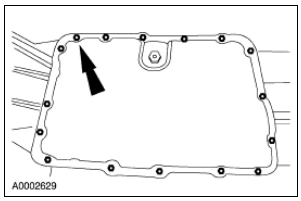


4. Remove the bracket.

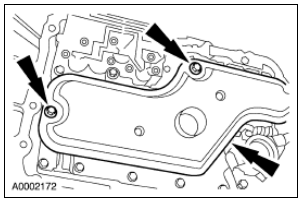


5. **NOTE:** The transmission fluid pan gasket is reusable, clean and inspect for damage; if not damaged, the gasket should be reused.

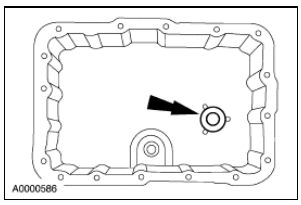
   Remove the fluid pan and gasket.



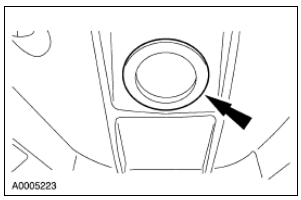
6. Remove and discard the transmission fluid filter.



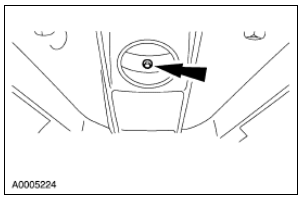
7. Clean and inspect the transmission fluid pan and magnet.



8. Remove the converter housing plug.



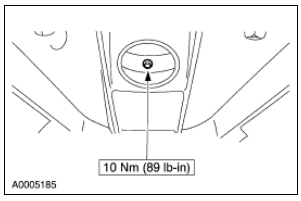
9. Remove the drain plug.



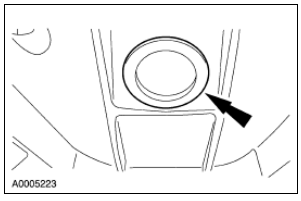
Installation

1. **NOTE:** A new converter drain plug must be used to prevent leakage.

   Install the drain plug.



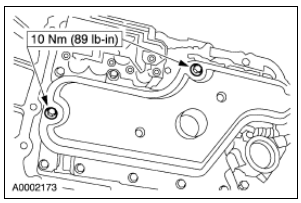
2. Install the converter housing access plug.



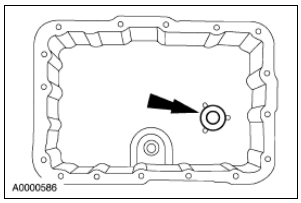
3. ⚠ **CAUTION: Lubricate the fluid filter O-ring seals with clean automatic transmission fluid or seals may be damaged.**

NOTE: Make sure that the fluid filter O-ring seals are correctly seated on the filter.

Lubricate the seals and install the transmission fluid filter.

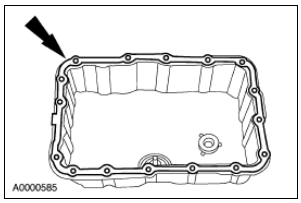


4. Install the oil pan magnet in the transmission fluid pan.

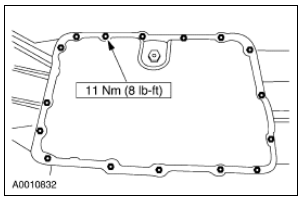


5. **NOTE:** The transmission fluid pan gasket is reusable, clean and inspect for damage; if not damaged, the gasket should be reused.

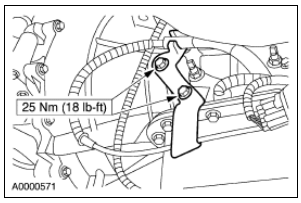
   Install the transmission fluid pan and gasket and loosely install the screws.



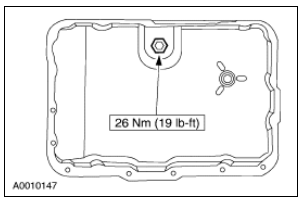
6. Using a crisscross sequence, tighten the screws.



7. Install the shifter cable bracket.



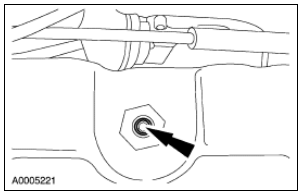
8. Install the drain plug.



9. **NOTE:** It will be necessary to hold the drain plug (larger plug) with a wrench when removing the fluid level indicator plug.

   NOTE: Use 3/16 inch Allen key to remove the fluid level indicator plug.

   Remove the fluid level indicator plug.



10. Carry out fluid level check. For additional information, refer to Transmission Fluid Level Check in this section.

Main Control Valve Body

Special Tool(s)

 ST1639-A	Aligner, Valve Body 307-334 (T95L-70010-C) (2 req'd)

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

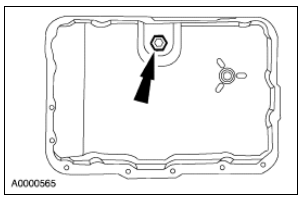
Removal

1. **NOTE:** When the battery is disconnected or a new battery installed, certain transmission operating parameters can be lost. The powertrain control module (PCM) must relearn these parameters. During this learning process, you may experience slightly firm shifts, delayed, or early shifts. This operation is considered normal and will not affect the function of the transmission. Normal operation will return once these parameters are stored by the PCM.

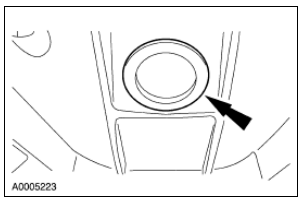
   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Raise and support the vehicle. For additional information, refer to Section 100-02 .

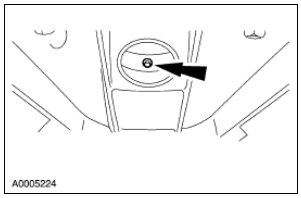
3. Drain the transmission fluid.



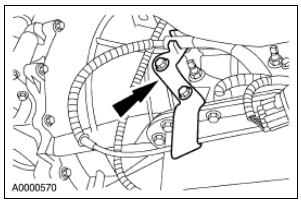
4. Remove the converter housing plug.



5. Remove the drain plug.

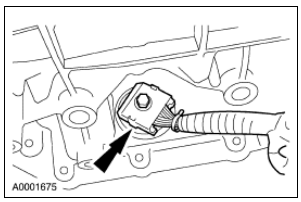


6. Remove the shifter cable bracket.

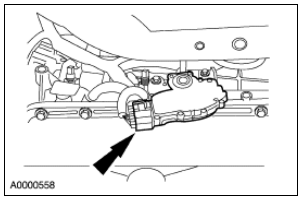


7. **NOTE:** Clean the area around connector to prevent contamination of the solenoid body connector.

   Disconnect the transmission connector.

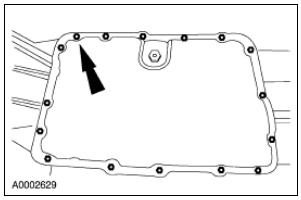


8. Disconnect the digital transmission range (TR) sensor connector.

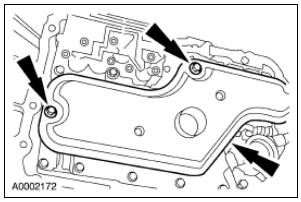


9. **NOTE:** The transmission fluid pan gasket is reusable. Clean and inspect for damage. If not damaged, the gasket should be reused.

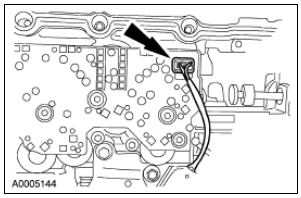
   Remove the transmission fluid pan and gasket.



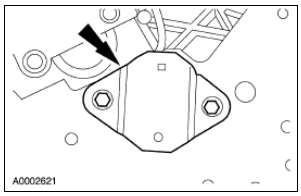
10. Remove the transmission fluid filter.



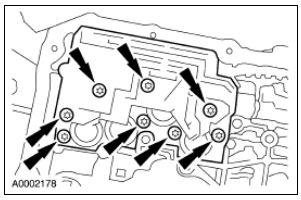
11. Disconnect the reverse pressure switch connector.



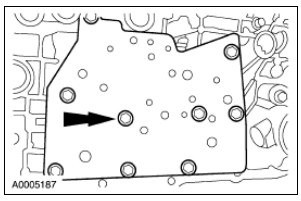
12. Remove the reverse pressure switch and discard.



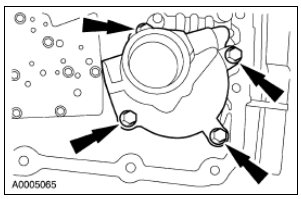
13. Remove the solenoid body.



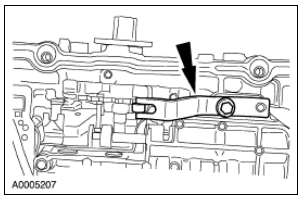
14. Remove the valve body cover plate and gasket.



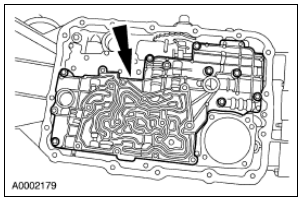
15. Remove the reverse servo.



16. Remove the manual control valve detent spring.

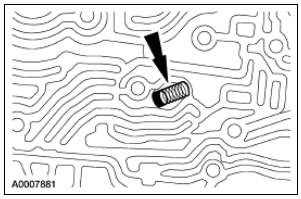


17. Remove the main control valve body, separator plate and gasket.



18. **NOTE:** The intermediate clutch spring and seal will fall out of the case.

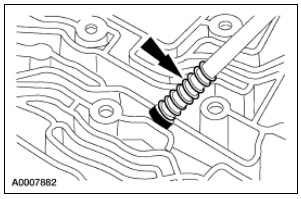
    Remove the intermediate clutch spring and seal.



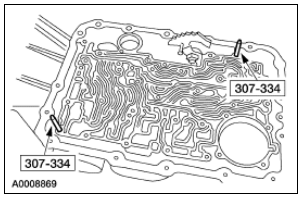
Installation

1. ⚠ **CAUTION: The intermediate clutch fluid inlet tube seal and spring must be correctly seated in the case. Failure to correctly seat the inlet tube seal and spring will cause an internal fluid leak and transmission damage.**

   Using a drift punch, correctly install and seat the intermediate clutch fluid inlet tube seal and spring into the case.



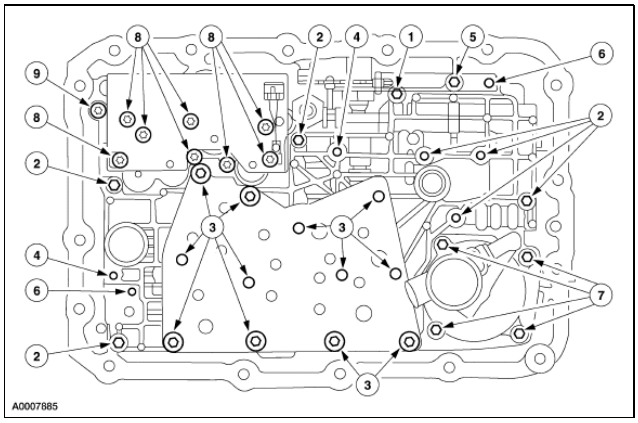
2. Install the special tools into the transmission case.



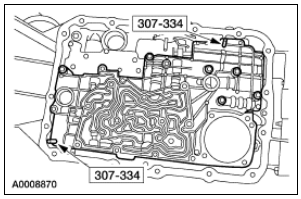
3. Refer to the following chart for bolt locations:

Item	Part Number	Part Name	Size
1	W702791-S300	Hex bolt	M6 X 27
2	W500103-S1300	Hex bolt	M6 X 45
3	W703133-S1300	Hex bolt	M6 X 52
4	W705559-S300	Hex bolt	M6 X 82.2
5	W500100-S300	Hex bolt	M6 X 30
6	W701099-S1430	Cap int lob screw	M6 X 20
7	W703135-S1300	Hex bolt	M6 X 70
8	W703189-S1430	Cap int lob 8	M6 X 63

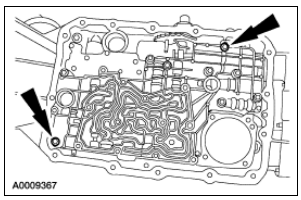
9	W702921-S430	Cap int lob 8	M6 X 25



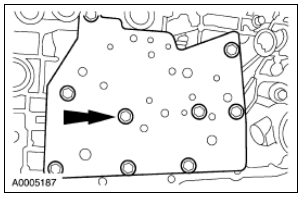
4. Install the main control valve body and loosely install the screws.



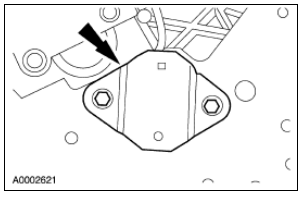
5. Remove the special tools and loosely install the screws.



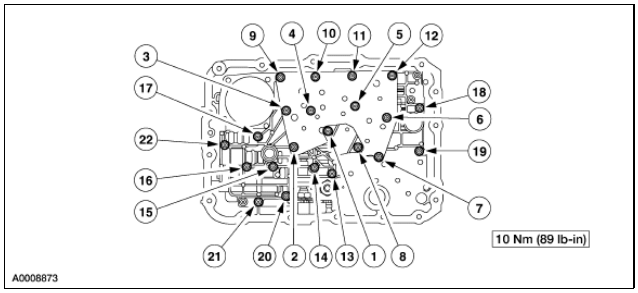
6. Install the valve body cover plate and gasket and loosely install the screws.



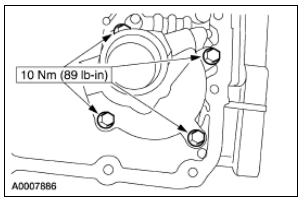
7. Install the reverse pressure switch and loosely install the screws.



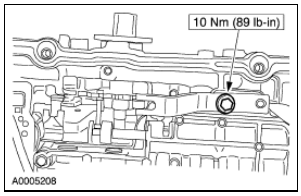
8. Tighten the screws in the sequence shown.



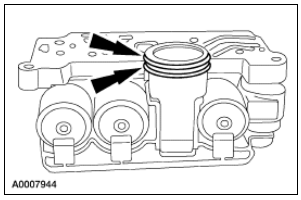
9. Install the reverse servo, using a crisscross pattern to tighten the bolts.



10. Install the manual control valve detent spring.

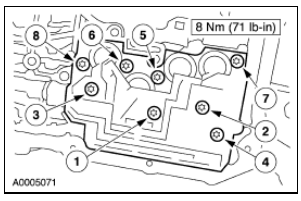


11. Install new O-ring seals on the solenoid body connector. Lubricate the O-ring seals with clean automatic transmission fluid.

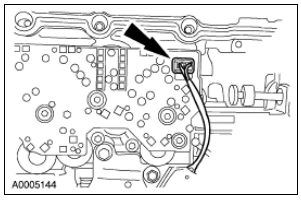


12. ⚠ **CAUTION: Inspect the transmission case bore to make sure it is free of foreign material and not damaged. If it is damaged, transmission leak may occur.**

    Install the solenoid body. Tighten the bolts in sequence shown.



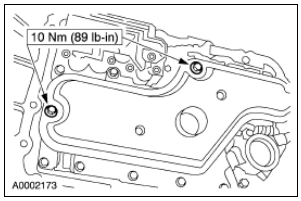
13. Connect the reverse pressure switch connector.



14. ⚠ **CAUTION: Lubricate the fluid filter O-ring seals with clean automatic transmission fluid or seals can be damaged.**

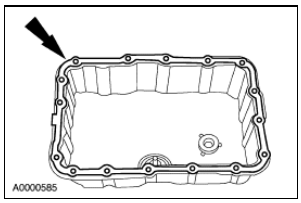
    NOTE: Make sure that the fluid filter O-ring seals are correctly seated on the filter.

    Lubricate the seals and install the transmission fluid filter.

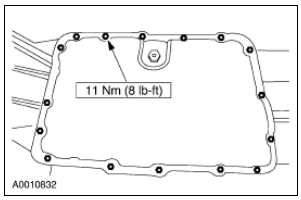


15. **NOTE:** The transmission fluid pan gasket is reusable. Clean and inspect for damage. If not damaged, the gasket should be reused.

    Install the transmission fluid pan and gasket and loosely install the screws.

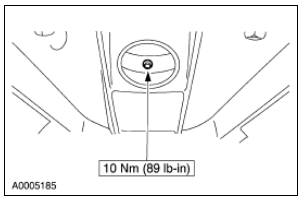


16. Using a crisscross sequence, tighten the screws.

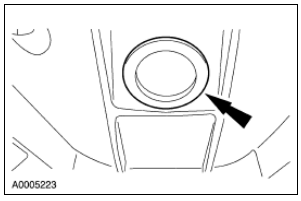


17. **NOTE:** A new converter drain plug must be used to prevent leakage.

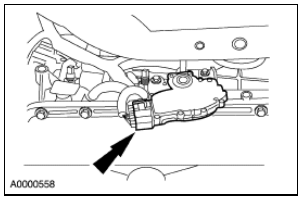
    Install the drain plug.



18. Install the converter housing access plug.



19. Reconnect the digital TR sensor connector.



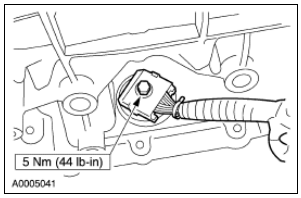
20. ⚠ **CAUTION: Damage to the solenoid body assembly can result if the screw is tightened above specification.**

    NOTE: Always install new O-ring seals on vehicle harness connector.

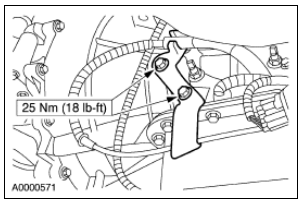
    NOTE: Clean the area around connector to prevent contamination of the solenoid body connector.

    NOTE: Use petroleum jelly to lubricate the O-ring seals to aid in the installation process.

    Install and lubricate new O-ring seals on the transmission connector and connect the connector.



21. Install the shift cable bracket.



22. Lower the vehicle.

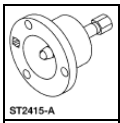
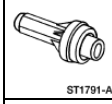
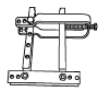
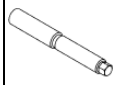
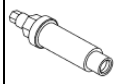
23. **NOTE:** When the battery is disconnected or a new battery installed, certain transmission operating parameters can be lost. The powertrain control module (PCM) must relearn these parameters. During this learning process, you may experience slightly firm shifts, delayed, or early shifts. This operation is considered normal and will not affect the function of the transmission. Normal operation will return once these parameters are stored by the PCM.

    Connect the battery ground cable. For additional information, refer to Section 414-01 .

24. Fill the transmission to the correct fluid level and check for correct transmission operation. For additional information, refer to Transmission Fluid Level Check in this section.

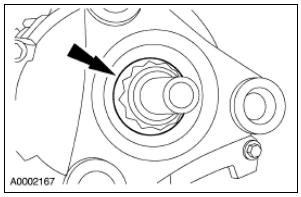
Extension Housing Seal

Special Tool(s)

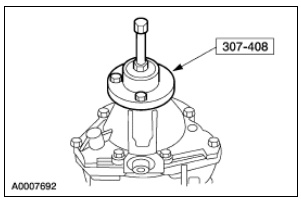
 ST2415-A	Remover, Output Flange 307-408
 ST1791-A	Installer, Transmission Extension Housing Fluid Seal 307-038 (T74P-77052-A)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1758-A	Remover, Torque Converter Fluid Seal 307-309 (T94P-77001-BH)
 ST2416-A	Installer, Output Shaft Flange 307-404
 ST2440-A	Installer, Drive Pinion Flange 205-479

Removal

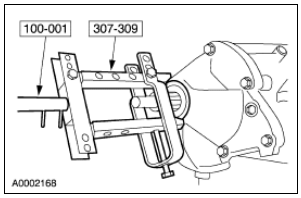
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the exhaust. For additional information, refer to Section 309-00 .
3. Remove the driveshaft. For additional information, refer to Section 205-01 .
4. Remove the nut and discard.



5. Using the special tool, remove the output flange.

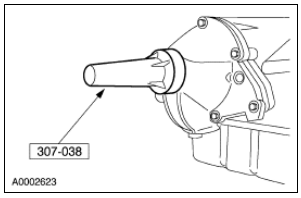


6. Using the special tools, remove the extension housing seal.

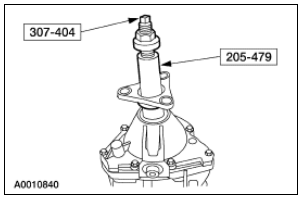


Installation

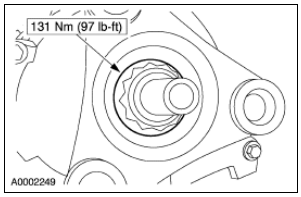
1. Using the special tool, install the extension housing seal.



2. Using the special tools, install the output flange.



3. Install a new nut.



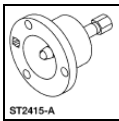
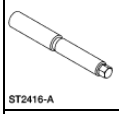
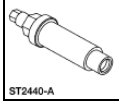
4. Install the driveshaft. For additional information, refer to Section 205-01 .

5. Install the exhaust. For additional information, refer to Section 309-00 .

6. Fill the transmission to the correct fluid level and check for correct transmission operation. For additional information, refer to Transmission Fluid Level Check in this section.

Extension Housing Gasket

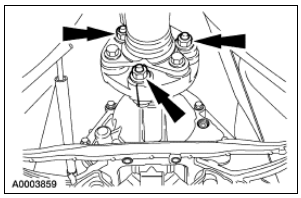
Special Tool(s)

 ST2415-A	Remover, Output Flange 307-408
 ST2416-A	Installer, Output Shaft Flange 307-404
 ST2440-A	Installer, Drive Pinion Flange 205-479

Removal

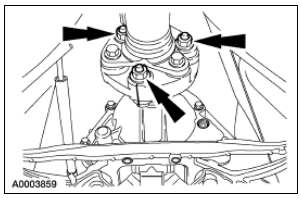
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the exhaust heat shield. For additional information, refer to Section 309-00 .
3. ⚠ **CAUTION: Index-mark (color paint) the bolts, washers, nuts, and the flex coupling to the transmission flange and the pinion flange to make sure they are installed in the same location. Components not assembled in their original locations can cause driveshaft imbalance.**

   Index-mark the front driveshaft pinion flange.

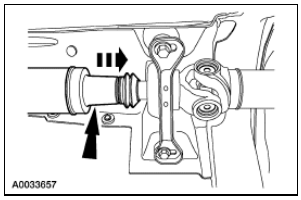

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4. ⚠ **CAUTION: Do not remove the bolts retaining the flex coupling to the driveshaft.**

   Remove the three nuts, washers and bolts.

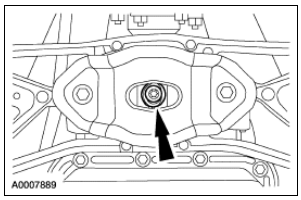

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5. Slide the front portion of the driveshaft toward the rear of the vehicle.

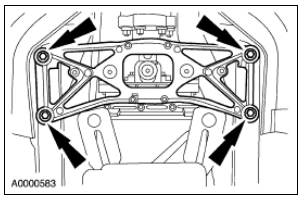


6. Support the transmission with a transmission jack.

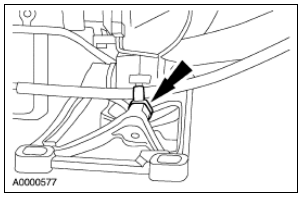
7. Remove the bolt.



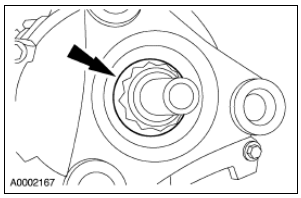
8. Remove the bolts.



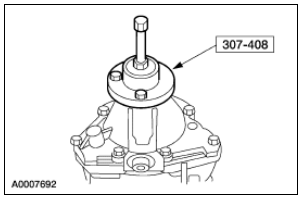
9. Disconnect the shift cable.



10. Remove the nut and discard.

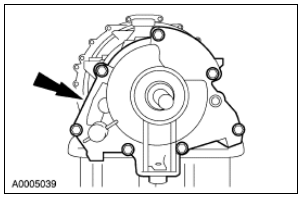


11. Using the special tool, remove the output flange.

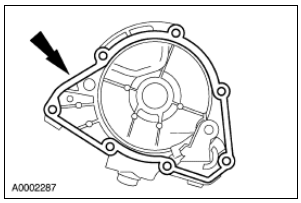


12. ⚠ **CAUTION: The parking pawl, parking pawl return spring and parking pawl shaft could fall out during removal of the extension housing.**

    Remove the extension housing.

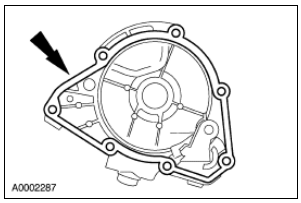


13. Remove and discard the extension housing gasket.



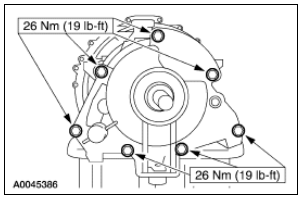
Installation

1. Clean the extension housing and install new extension housing gasket. Make sure that the park pawl is installed correctly.

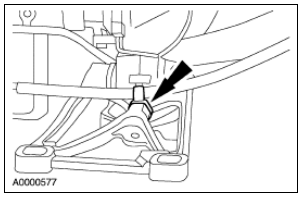


2. ⚠ **CAUTION: Make sure the parking lever actuating rod is correctly seated into the case parking rod guide cup.**

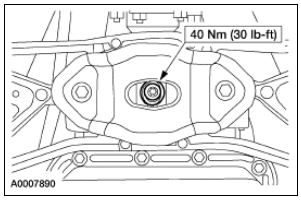
   Install the extension housing.



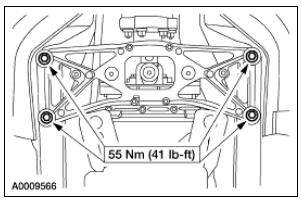
3. Install the shift cable.



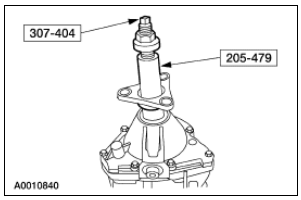
4. Install the rear mount.



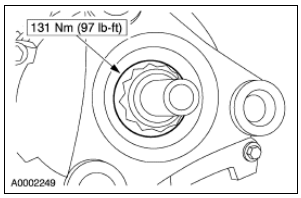
5. Install the rear mount.



6. Using the special tools, install the output flange.

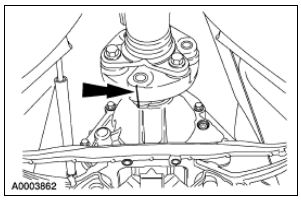


7. Install a new nut.



8. ⚠ **CAUTION: Align the index marks or driveshaft imbalance can occur.**

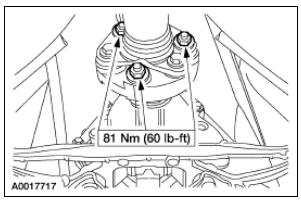
   Align the index marks on the pinion flange made during removal and position the driveshaft in place.



9. ⚠ **CAUTION: Install the bolts, washers and nuts in their original positions or driveshaft imbalance can occur. Install the driveshaft flex coupling bolts with the head of the bolt seated against the flange, and the nuts seated against the flex coupling. Install the short bolts in the front and the long bolts in the rear.**

   Install the bolts, washers and nuts.

   - Coat the nut and bolt threads with threadlock sealer.



10. Install the exhaust heat shield. For additional information, refer to Section 309-00 .

11. Fill the transmission to the correct fluid level and check for correct transmission operation. For additional information, refer to Transmission Fluid Level Check in this section.

Solenoid Body Assembly

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM	MERCON® V

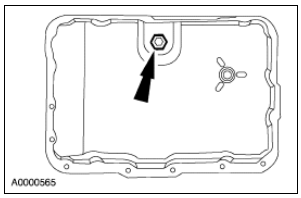
Removal

1. **NOTE:** When the battery is disconnected or a new battery installed, certain transmission operating parameters can be lost. The powertrain control module (PCM) must relearn these parameters. During this learning process, you may experience slightly firm shifts, delayed, or early shifts. This operation is considered normal and will not affect the function of the transmission. Normal operation will return once these parameters are stored by the PCM.

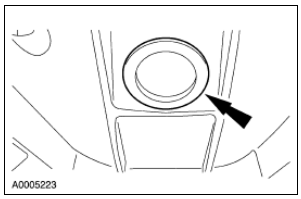
   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Raise and support the vehicle. For additional information, refer to Section 100-02 .

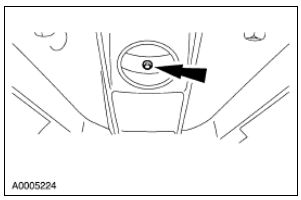
3. Drain the transmission fluid.



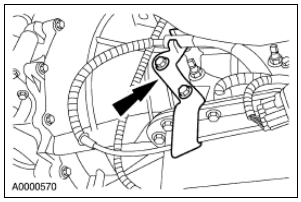
4. Remove the converter housing plug.



5. Remove the drain plug.

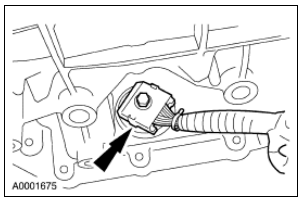


6. Remove the shift cable bracket.

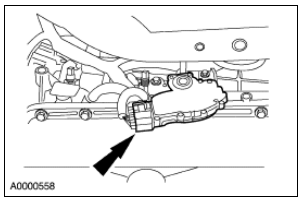


7. **NOTE:** Clean the area around connector to prevent contamination of the solenoid body connector.

   Disconnect the transmission connector.

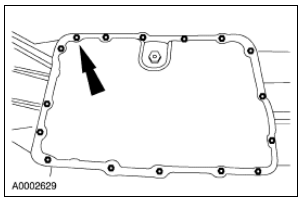


8. Disconnect the digital transmission range (TR) sensor connector.

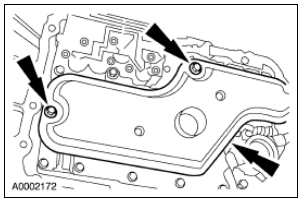


9. **NOTE:** The transmission fluid pan gasket is reusable. Clean and inspect for damage. If not damaged, the gasket should be reused.

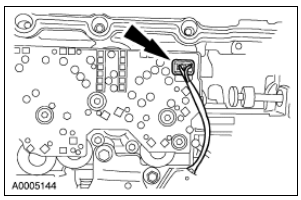
   Remove the transmission fluid pan and gasket.



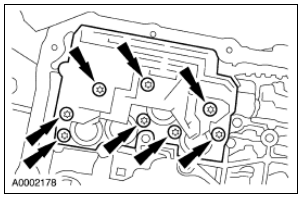
10. Remove the transmission fluid filter.



11. Disconnect the reverse pressure switch connector.

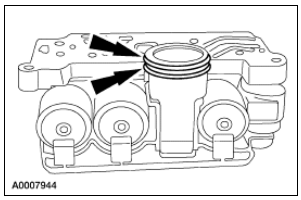


12. Remove the solenoid body.



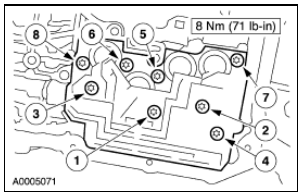
Installation

1. Install new O-ring seals on the solenoid body connector. Lubricate the O-ring seals with clean automatic transmission fluid.

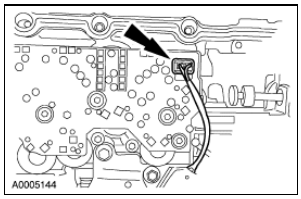


2. ⚠ **CAUTION: Inspect the transmission case bore to make sure it is free of foreign material and not damaged. If damaged, a transmission leak can result.**

   Install the solenoid body. Tighten the bolts in sequence shown.



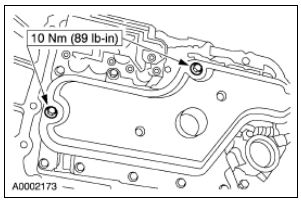
3. Connect the reverse pressure switch connector.



4. ⚠ **CAUTION: Lubricate the fluid filter O-ring seals with clean automatic transmission fluid or seals may be damaged.**

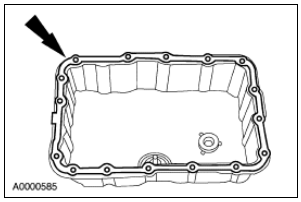
   NOTE: Make sure that the fluid filter O-ring seals are correctly seated on the filter.

   Lubricate the seals and install the transmission fluid filter.

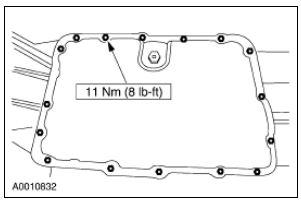


5. **NOTE:** The transmission fluid pan gasket is reusable. Clean and inspect for damage. If not damaged, the gasket should be reused.

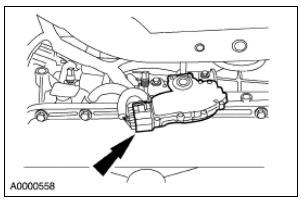
   Install the transmission fluid pan and gasket and loosely install the screws.



6. Using a crisscross sequence, tighten the screws.

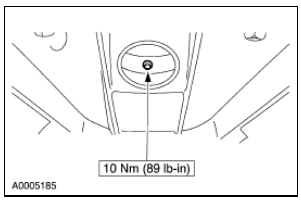


7. Reconnect the digital TR sensor connector.

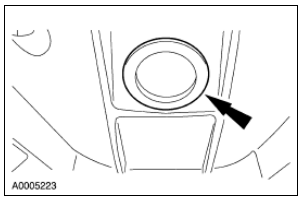


8. **NOTE:** A new converter drain plug must be used to prevent leakage.

   Install the drain plug.



9. Install the converter housing access plug.



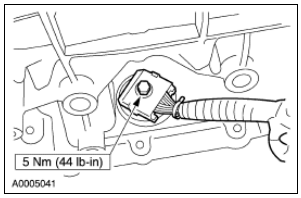
10. ⚠ **CAUTION: Damage to the solenoid body assembly can result if the screw is tightened above the specification.**

    NOTE: Always install new O-ring seals on vehicle harness connector.

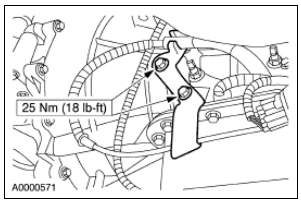
    NOTE: Clean the area around connector to prevent contamination of the solenoid body connector.

    NOTE: Use petroleum jelly to lubricate the O-ring seals to aid in the installation process.

    Install and lubricate new O-ring seals on the transmission connector and connect the connector.



11. Install the shift cable bracket.



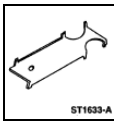
12. **NOTE:** When the battery is disconnected or a new battery installed, certain transmission operating parameters can be lost. The powertrain control module (PCM) must relearn these parameters. During this learning process, you may experience slightly firm shifts, delayed, or early shifts. This operation is considered normal and will not affect the function of the transmission. Normal operation will return once these parameters are stored by the PCM.

    Connect the battery ground cable. For additional information, refer to Section 414-01 .

13. Fill the transmission to the correct fluid level and check for correct transmission operation. For additional information, refer to Transmission Fluid Level Check in this section.

Digital Transmission Range (TR) Sensor

Special Tool(s)

 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)

Material

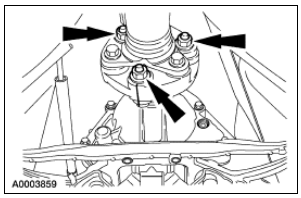
Item	Specification
Premium Long Life Grease XG-1-C	ESA-M1C75-B
Threadlock and Sealer E2FZ-19554-B	WSK-M2G351-A6

Removal

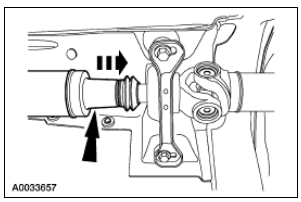
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the exhaust heat shield. For additional information, refer to Section 309-00 .
3. **⚠ CAUTION: Index-mark (color paint) the bolts, washers, nuts, and the flex coupling to the transmission flange and the pinion flange to to make sure they are installed in the same location. Components not assembled in their original locations can cause driveshaft imbalance.**

   ⚠ CAUTION: Do not remove the bolts retaining the flex coupling to the driveshaft.

   Index-mark the front driveshaft pinion flange. Remove the three nuts, washers and bolts.


A0003859

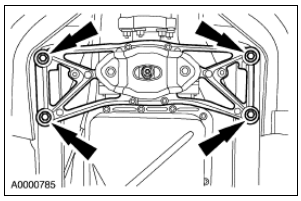
4. Slide the front shaft assembly rearward and support.


A0033657

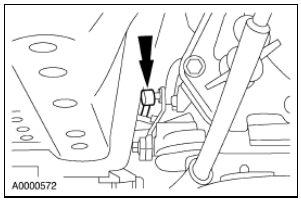
5. **⚠ WARNING: Secure the transmission to the transmission jack with a safety chain. Failure to follow these instructions may result in personal injury.**

   Support the transmission with a transmission jack.

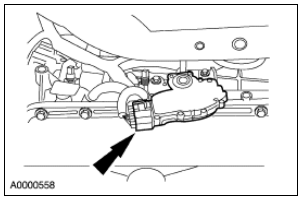
6. Remove the transmission mount and lower the transmission enough to gain access to the digital transmission range (TR) sensor.



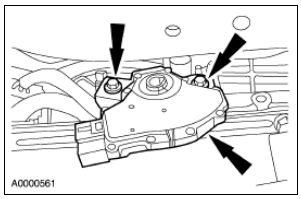
7. Disconnect the shift cable.



8. Disconnect the digital TR sensor connector.



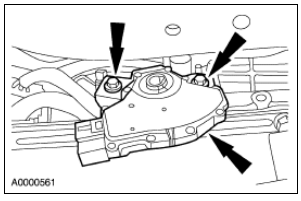
9. Remove the digital TR sensor.



Installation

1. ⚠ **CAUTION: The digital transmission range sensor must fit flush against the boss on the case to prevent damage to the sensor.**

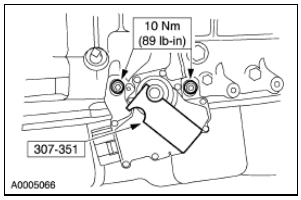
   Install the digital TR sensor and loosely install the screws.



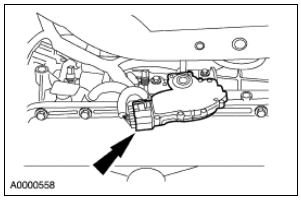
2. ⚠ **CAUTION: Tightening one screw before tightening the other may cause the sensor to bind or become damaged.**

   NOTE: The manual lever must be in the Neutral position.

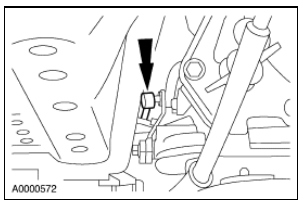
   Using the special tool, align the digital TR sensor and tighten the screws in an alternating sequence.



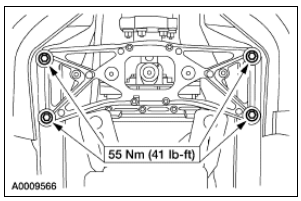
3. Reconnect the digital TR sensor connector.



4. Connect the shift cable.



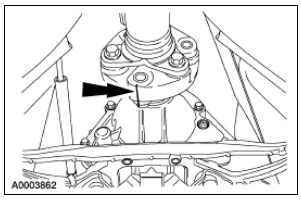
5. Install the rear mount.



6. Verify that the shift cable is adjusted. For additional information, refer to Section 307-05 .

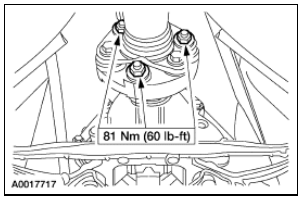
7. ⚠ **CAUTION: Align the index marks or driveshaft imbalance can occur.**

   Align index marks and position the alignment bushing on the transmission flange piloting system.



8. ⚠ **CAUTION: Install the bolts, washers and nuts in their original positions or driveshaft imbalance can occur. Install the driveshaft flex coupling bolts with the head of the bolt seated against the flange, and the nuts seated against the flex coupling. Install the short bolts in the front and the long bolts in the rear.**

   Install the bolts, washers and nuts. Coat the nut and bolt threads with threadlock sealer.



9. Install the exhaust heat shield. For additional information, refer to Section 309-00 .
10. Lower the vehicle.

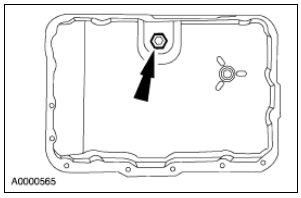
Reverse Servo Assembly

Material

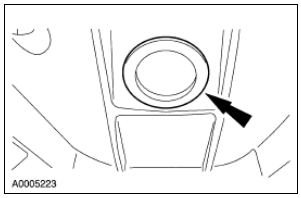
Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

Removal

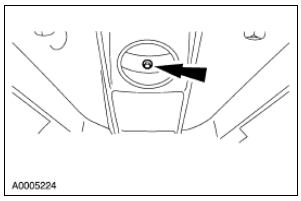
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Drain the transmission fluid.



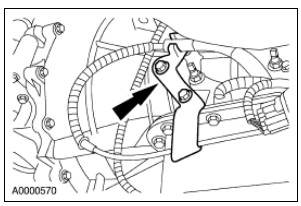
3. Remove the converter housing plug.



4. Remove the drain plug.

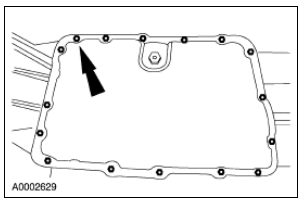


5. Remove the shift cable bracket.

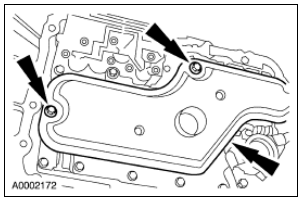


6. **NOTE:** The transmission fluid pan gasket is reusable, clean and inspect for damage; if not damaged, the gasket should be reused.

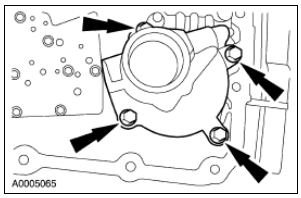
Remove the transmission fluid pan and gasket.



7. Remove the transmission fluid filter.

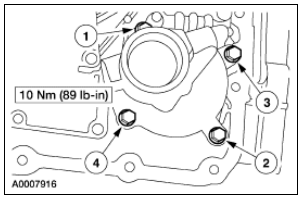


8. Remove the reverse servo.



Installation

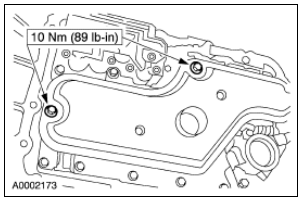
1. Install the reverse servo.
   - Install the bolts in the sequence shown.



2. ⚠ **CAUTION: Lubricate the fluid filter O-ring seals with clean automatic transmission fluid or seals may be damaged.**

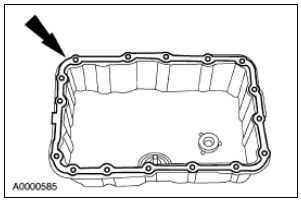
   NOTE: Make sure that the fluid filter O-ring seals are correctly seated on the filter.

   Lubricate the seals and install the transmission fluid filter.

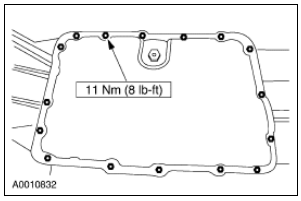


3. **NOTE:** The transmission fluid pan gasket is reusable, clean and inspect for damage; if not damaged, the gasket should be reused.

   Install the transmission fluid pan and gasket and loosely install the screws.

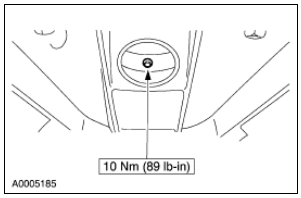


4. Using a crisscross sequence, tighten the screws.

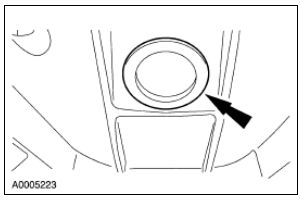


5. **NOTE:** A new converter drain plug must be used to prevent leakage.

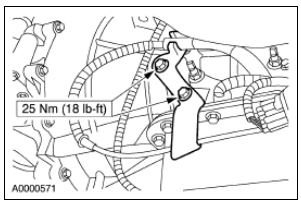
   Install the drain plug.



6. Install the converter housing access plug.



7. Install the shift cable bracket.

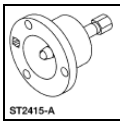
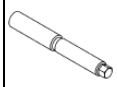
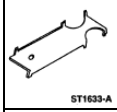
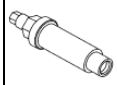


8. Lower the vehicle.

9. Fill the transmission to the correct fluid level and check for correct transmission operation. For additional information, refer to Transmission Fluid Level Check in this section.

Park System

Special Tool(s)

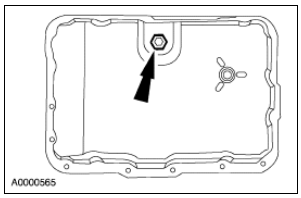
 ST2415-A	Remover, Output Flange 307-408
 ST2416-A	Installer, Output Shaft Flange 307-404
 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)
 ST2440-A	Installer, Drive Pinion Flange 205-479

Material

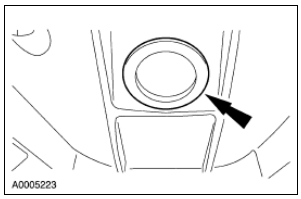
Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

Removal

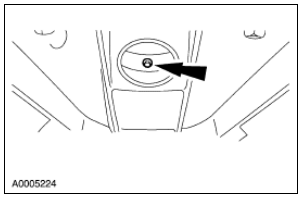
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Drain the transmission fluid.



3. Remove the converter housing plug.



4. Remove the drain plug.

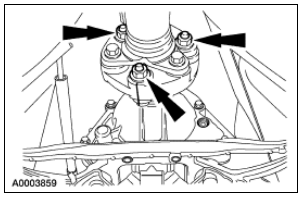


5. Remove the exhaust heat shield. For additional information, refer to Section 309-00 .

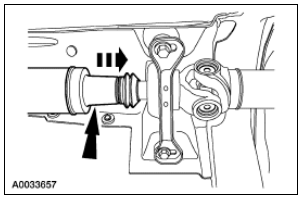
6. **⚠ CAUTION: Index-mark (color paint) the bolts, washers, nuts, and the flex coupling to the transmission flange and the pinion flange to make sure they are installed in the same location. Components not assembled in their original locations can cause driveshaft imbalance.**

   ⚠ CAUTION: Do not remove the bolts retaining the flex coupling to the driveshaft.

   Index-mark the front driveshaft pinion flange. Remove the three nuts, washers and bolts.



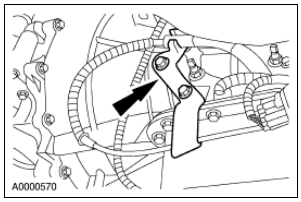
7. Slide the front portion of the driveshaft toward the rear of the vehicle.



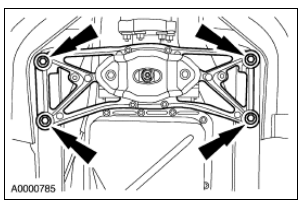
8. **⚠ WARNING: Secure the transmission to the transmission jack with a safety chain. Failure to follow these instructions may result in personal injury.**

   Support the transmission with a transmission jack.

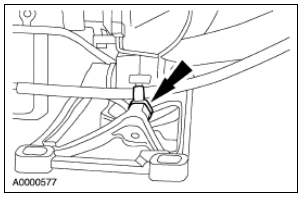
9. Remove the shift cable bracket.



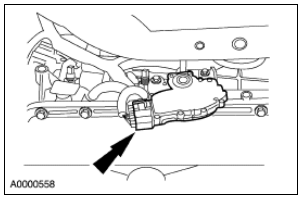
10. Remove the transmission mount.



11. Disconnect the shift cable.

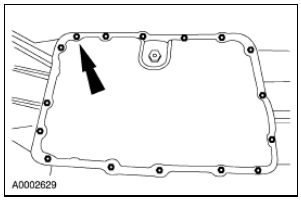


12. Disconnect the digital transmission range (TR) sensor connector.

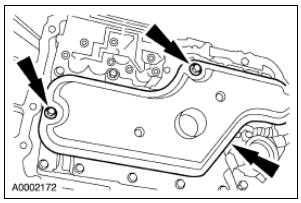


13. **NOTE:** The transmission fluid pan gasket is reusable, clean and inspect for damage; if not damaged, the gasket should be reused.

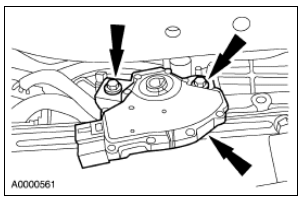
    Remove the transmission fluid pan and gasket.



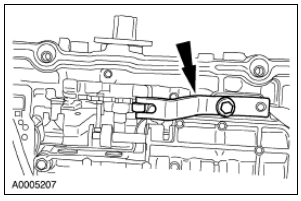
14. Remove the transmission fluid filter.



15. Remove the digital TR sensor.

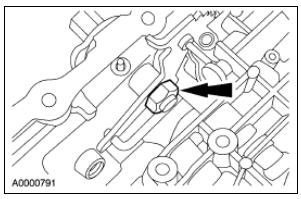


16. Remove the manual control valve detent spring.

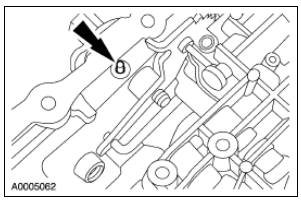


17. ⚠ **CAUTION: To avoid damage, make sure the wrench does not strike the manual valve inner lever pin.**

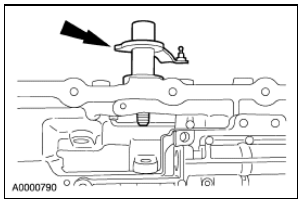
Remove the nut.



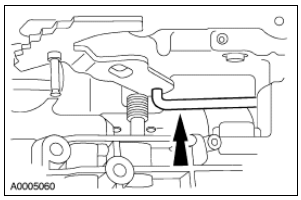
18. Remove the manual lever shaft retaining pin.



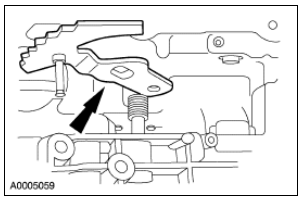
19. Partially remove the manual control lever shaft.



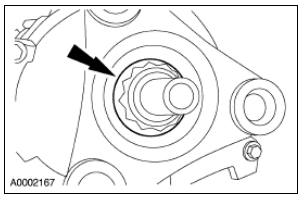
20. Disconnect the manual valve inner lever from the parking lever actuating rod.



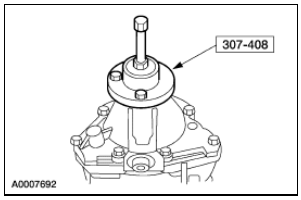
21. Remove the manual valve inner lever.



22. Remove the nut and discard.



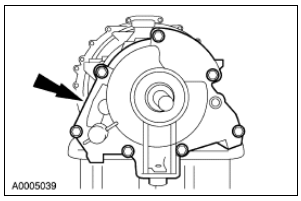
23. Using the special tool, remove the output shaft flange.



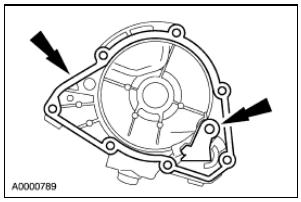
24. **NOTE:** If damage is found to the parking gear, the transmission must be removed and disassembled.

    NOTE: The parking pawl, parking pawl return spring and parking pawl shaft may fall out during removal of the extension housing.

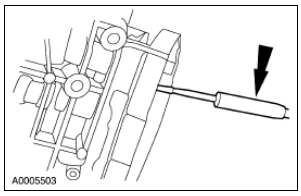
    Remove the extension housing.



25. Remove and discard the gasket. Inspect the parking pawl, parking pawl return spring, and the parking pawl shaft. Discard components if damaged or worn.

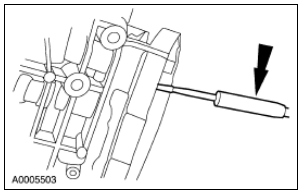


26. Remove the parking lever actuating rod.

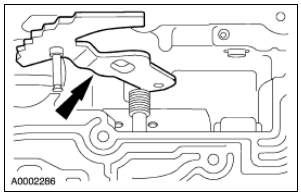


Installation

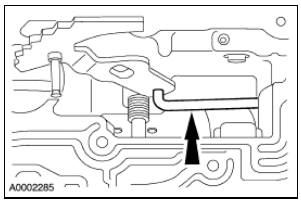
1. Install the parking lever actuating rod.



2. Install the manual control lever.

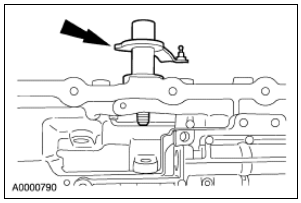


3. Assemble the manual valve inner lever and parking lever actuating rod as shown.

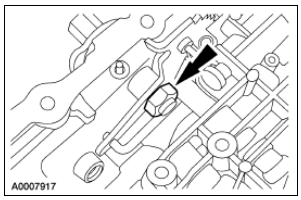


4. ⚠ **CAUTION: Align the flats on the manual valve inner lever with the flats on the manual control lever shaft.**

   Align the flats of the manual inner lever with the flats on the manual control lever shaft. Install the manual valve inner lever and parking lever actuating rod onto the manual control lever shaft.



5. Install the manual valve inner lever onto the manual shaft and loosely install the nut.

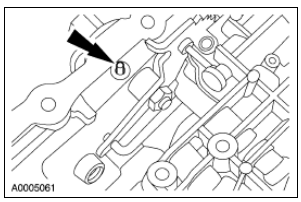


6. ⚠ **CAUTION: Use care not to damage the fluid pan rail surface when installing the retaining pin.**

   NOTE: Align the manual control lever shaft alignment groove with the manual control lever shaft spring pin bore in the transmission case.

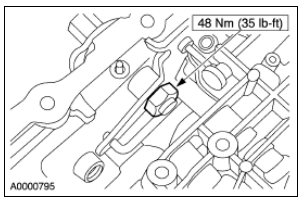
   Install the manual control lever shaft spring pin.

   - Tap the manual control lever shaft spring pin into the transmission case.

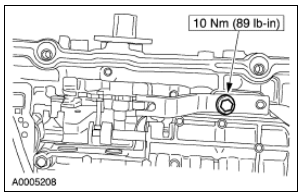


7. ⚠ **CAUTION: To avoid damage, do not allow the wrench to strike the manual valve inner lever pin.**

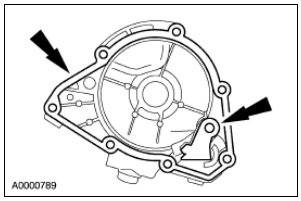
Tighten the nut.



8. Install the manual valve detent spring.

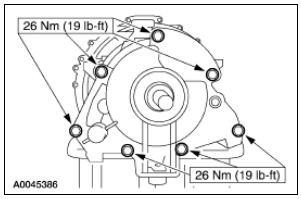


9. Clean the extension housing and install a new extension housing gasket. Make sure that the parking pawl is correctly installed.



10. ⚠ **CAUTION: Make sure the parking lever actuating rod is correctly seated into the case parking rod guide cup.**

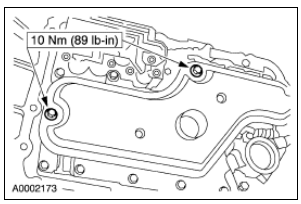
    Install the extension housing.



11. ⚠ **CAUTION: Lubricate the fluid filter O-ring seals with clean automatic transmission fluid or seals may be damaged.**

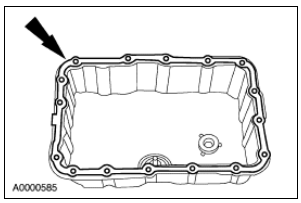
    NOTE: Make sure that the fluid filter O-ring seals are correctly seated on the filter.

    Lubricate the seals and install the transmission fluid filter.

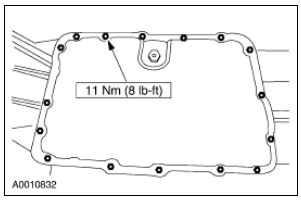


12. **NOTE:** The transmission fluid pan gasket is reusable, clean and inspect for damage; if not damaged, the gasket should be reused.

Install the transmission fluid pan and gasket and loosely install the screws.

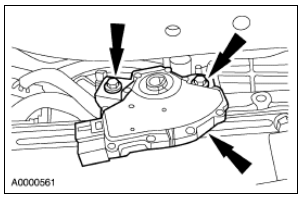


13. Using a crisscross sequence, tighten the screws.



14. ⚠ **CAUTION: The digital transmission range sensor must fit flush against the boss on the case to prevent damage to the sensor.**

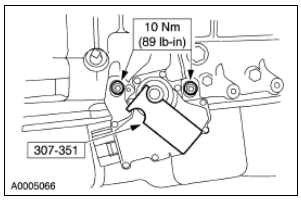
    Install the digital TR sensor and loosely install the screws.



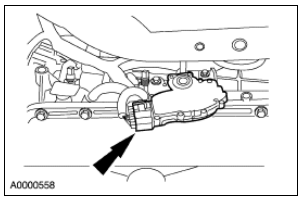
15. ⚠ **CAUTION: Tightening one screw before tightening the other may cause the sensor to bind or become damaged.**

    NOTE: The manual lever must be in the Neutral position.

    Using the special tool, align the digital TR sensor and tighten the screws in an alternating sequence.

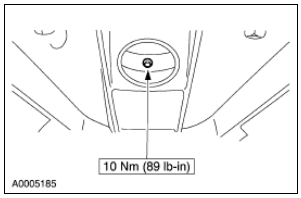


16. Reconnect the digital TR sensor connector.

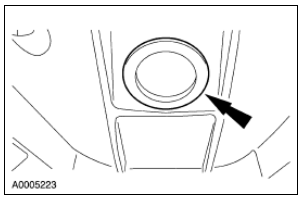


17. **NOTE:** A new converter drain plug must be used to prevent leakage.

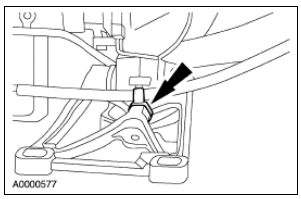
    Install the drain plug.



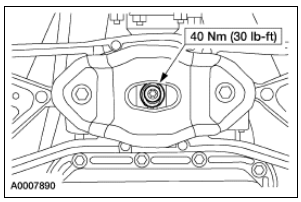
18. Install the converter housing access plug.



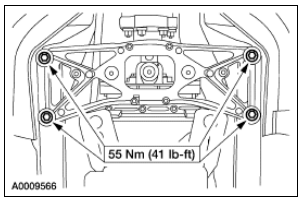
19. Install the shift cable.



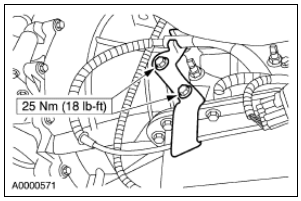
20. Install the rear mount.



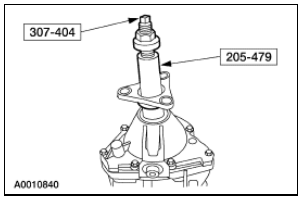
21. Install the rear mount.



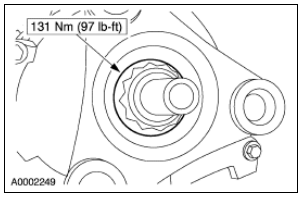
22. Install the shift cable bracket.



23. Using the special tools, install the output flange.

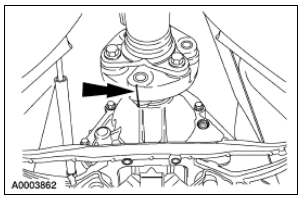


24. Install a new nut.



25. ⚠ **CAUTION: Align the index marks or driveshaft imbalance can occur.**

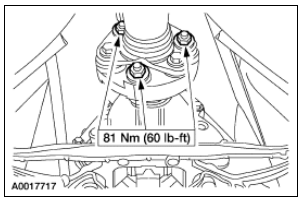
    Align the index marks on the pinion flange made during removal and position the driveshaft in place.



26. ⚠ **CAUTION: Install the bolts, washers and nuts in their original positions or driveshaft imbalance can occur. Install the driveshaft flex coupling bolts with the head of the bolt seated against the flange, and the nuts seated against the flex coupling. Install the short bolts in the front and the long bolts in the rear.**

    Install the bolts, washers and nuts.

    - Coat the nut and bolt threads with threadlock sealer.



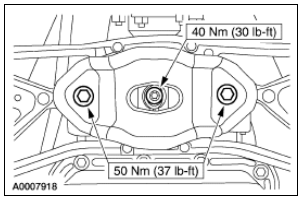
27. Install the exhaust heat shield. For additional information, refer to Section 309-00 .

28. Fill the transmission to the correct fluid level and check for correct transmission operation. For additional information, refer to Transmission Fluid Level Check in this section.

Transmission Support Insulator

Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Support the transmission with a transmission jack.
3. Remove the bolts.



4. To install, reverse the removal procedure.

Transmission

NOTE: If the transmission is to be removed for a period of time, support the engine with a safety stand and a wood block.

1. **NOTE:** When the battery is disconnected or a new battery installed, certain transmission operating parameters can be lost. The powertrain control module (PCM) must relearn these parameters. During this learning process, you may experience slightly firm shifts, delayed, or early shifts. This operation is considered normal and will not affect the function of the transmission. Normal operation will return once these parameters are stored by the PCM.

   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

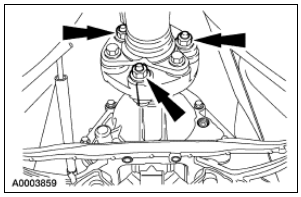
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .

3. Remove the exhaust heat shield. For additional information, refer to Section 309-00 .

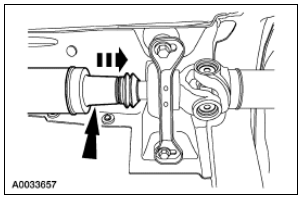
4. ⚠ **CAUTION: Index-mark (color paint) the bolts, washers, nuts, and the flex coupling to the transmission flange and the pinion flange to make sure they are installed in the same location. Components not assembled in their original locations can cause driveshaft imbalance.**

   ⚠ **CAUTION: Do not remove the bolts retaining the flex coupling to the driveshaft.**

   Index-mark the front driveshaft pinion flange. Remove the three nuts, washers and bolts.



5. Slide the front shaft assembly rearward and support.

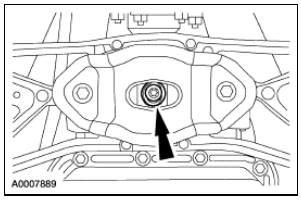


6. If transmission disassembly is necessary, drain the transmission fluid. For additional information, refer to Transmission Fluid Drain and Refill - Automated Equipment , Transmission Fluid Drain and Refill - Vehicles With Torque Converter Drain Plug or Transmission Fluid Drain and Refill - Vehicles Without Torque Converter Drain Plug in this section.

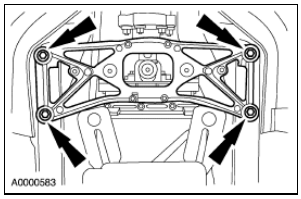
7. ⚠ **WARNING: Secure the transmission to the transmission jack with a safety chain. Failure to follow these instructions can result in personal injury.**

   Support the transmission with a transmission jack.

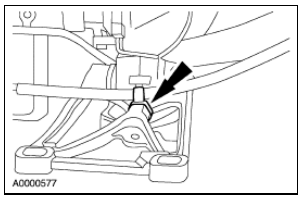
8. Remove the transmission mount.



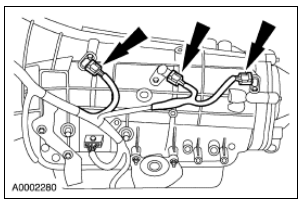
9. Remove the transmission mount.



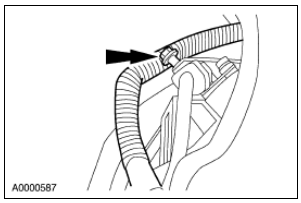
10. Disconnect the shift cable.



11. Lower the transmission enough to gain access to the sensors. Disconnect the turbine shaft speed (TSS) sensor, output shaft speed (OSS) sensor and intermediate shaft speed (ISS) sensor electrical connectors.

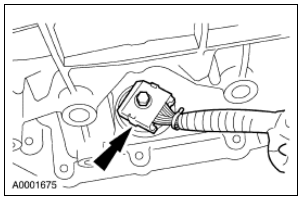


12. Remove the screw from the harness.

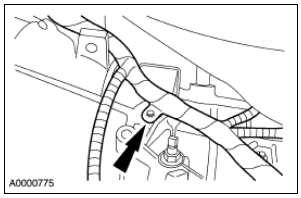


13. **NOTE:** Clean the area around connector to prevent contamination of the solenoid body connector.

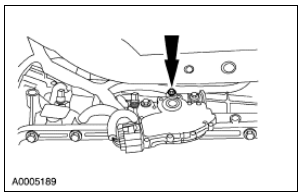
    Disconnect the transmission connector.



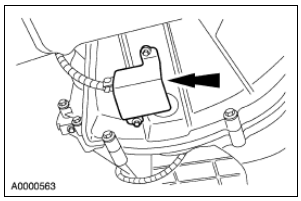
14. Disconnect the harness retainer.



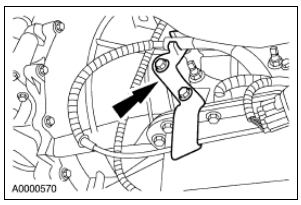
15. Disconnect the harness retainer.



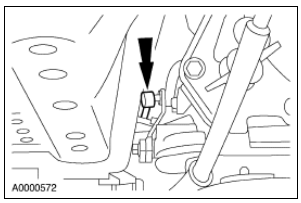
16. Remove the heated oxygen sensor (HO2S) connector.



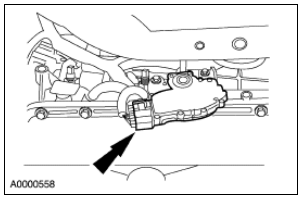
17. Remove the shifter cable bracket.



18. Disconnect the shifter cable from the manual lever.

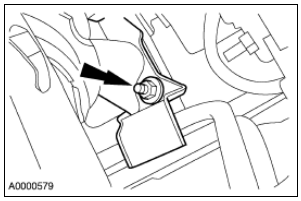


19. Disconnect the digital transmission range (TR) sensor connector.



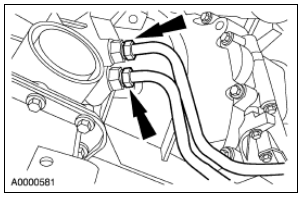
20. **NOTE:** V8 application shown; V6 application similar.

    Disconnect the transmission cooler line bracket.



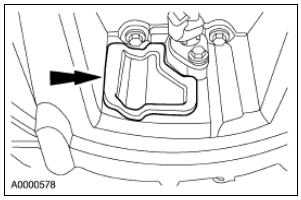
21. ⚠ **CAUTION: Do not damage the cooler tubes.**

    Disconnect the transmission cooler tubes.



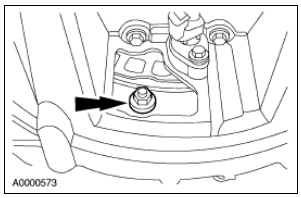
22. On 3.0L engines only, remove the starter motor. For additional information, refer to Section 303-06 .

23. Remove the access cover.

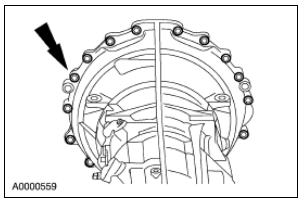


24. **NOTE:** Make an identifying mark on the nut, stud and adapter plate to allow for correct installation.

    Remove the nuts.



25. Remove the bolts.

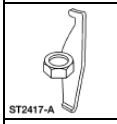
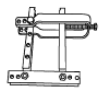
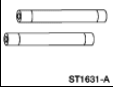
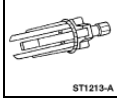


26. Lower the transmission from the vehicle.

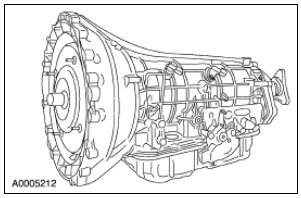
27. Backflush and clean the transmission fluid cooler. For additional information, refer to Section 307-02 .

Transmission

Special Tool(s)

 ST2408-A	Air Test Plate, Transmission 307-405
 ST2417-A	Remover, Input Shaft Oil Seal 308-375
 ST2418-A	Remover, Transmission Fluid Pump 307-397
 ST2424-A	Compressor, Cushion Spring 307-401
 ST1104-B	Retaining Ring Pliers 307-343 (T95P-77001-AHR)
 ST2415-A	Remover, Output Flange 307-408
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST1758-A	Remover, Torque Converter Fluid Seal 307-309 (T94P-77001-BH)
 ST2393-A	Compressor, Servo Cover 307-402
 ST1631-A	Handle, Torque Converter 307-091 (T81P-7902-C)
 ST1213-A	Remover, Bushing 307-001 (TOOL-1175-AC) or equivalent

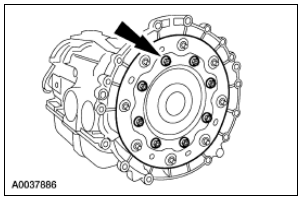
1. Place the transmission on a workbench.



2. If vehicle is equipped, remove the torque converter adapter plate assembly.

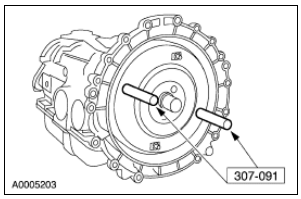
3. **NOTE:** Make an identifying mark on the nut, stud, and adapter plate to allow for correct installation.

   If the vehicle is equipped and installation of a new or remanufactured torque converter is necessary, remove the torque converter adapter plate.



4. ⚠ **WARNING: The torque converter is heavy, especially when full of fluid.**

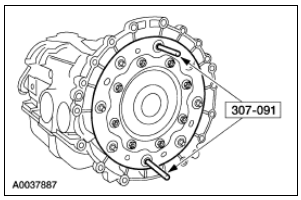
   Using the special tools, remove the torque converter.



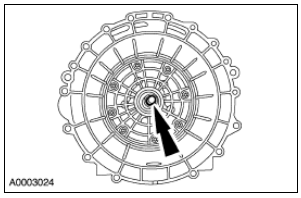
5. ⚠ **WARNING: The torque converter is heavy, especially when full of fluid.**

   NOTE: If not installing a new torque converter leave the adapter bolted to the torque.

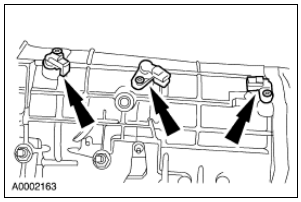
   Using the special tools, remove the torque converter and adapter plate as an assembly.



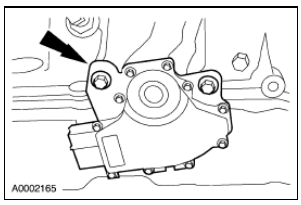
6. Remove the input shaft.



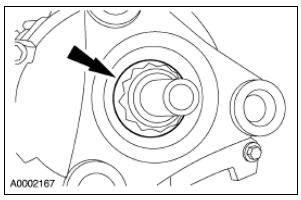
7. Remove the sensors.



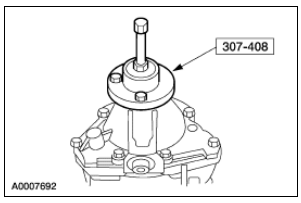
8. Remove the digital transmission range (TR) sensor.



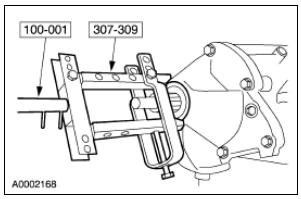
9. Remove and discard the nut.



10. Using the special tool, remove the output shaft flange.

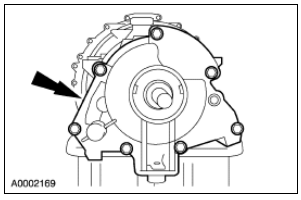


11. Using the special tools, remove the extension housing seal.



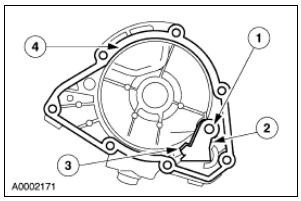
12. ⚠ **CAUTION: The parking pawl, parking pawl return spring and parking pawl shaft could fall out during removal of the extension housing.**

    Remove the extension housing.



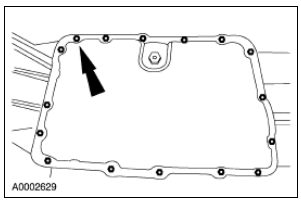
13. Remove the parking pawl assembly and discard the gasket.
    1. Remove the parking pawl shaft.
    2. Remove the parking pawl.

3. Remove the parking pawl return spring.
4. Remove and discard the gasket.

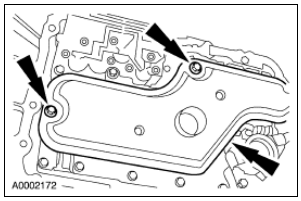


14. **NOTE:** The transmission fluid pan gasket is reusable. Clean and inspect the gasket for damage. If not damaged, the gasket should be reused.

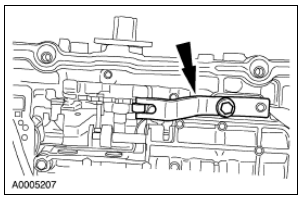
    Remove the transmission fluid pan and gasket.



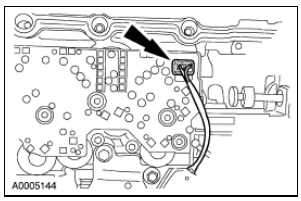
15. Remove the transmission fluid filter and discard.



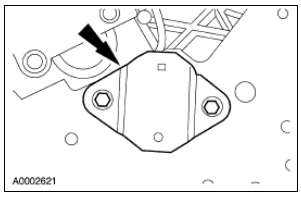
16. Remove the manual control valve detent spring.



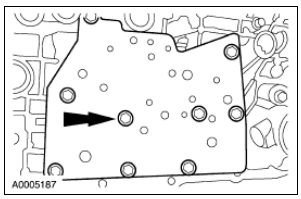
17. Disconnect the reverse pressure switch connector.



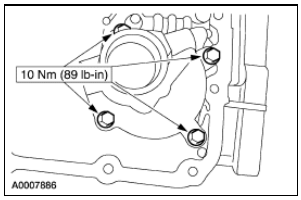
18. Remove the reverse pressure switch and discard.



19. Remove the valve body cover plate and gasket. Discard the gasket.

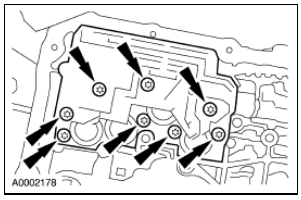


20. Remove the reverse servo assembly.

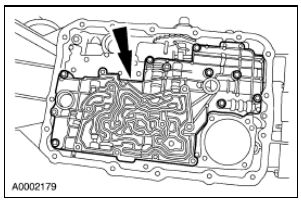


21. ⚠ **CAUTION: Do not damage solenoid body connector pins.**

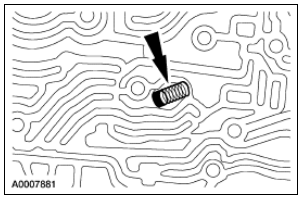
    Remove the solenoid body assembly by lifting on the body and pushing the connector from the other side of the case.



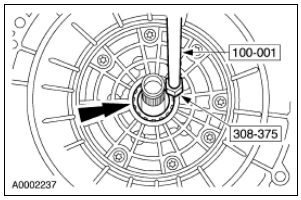
22. Remove the main control valve body, separator plate, and gasket.



23. Remove the intermediate clutch spring and seal.



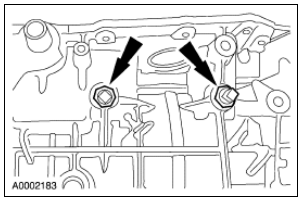
24. Using the special tools, remove the converter hub seal.



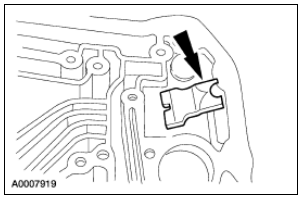
25. ⚠ **CAUTION: Failure to loosen the OD band adjusting screw prior to pump removal may cause damage to the pump and OD band.**

    ⚠ **CAUTION: Throw the locknuts away. The locknuts are not reusable for assembly.**

    Remove the locknuts, and loosen the OD band adjusting screw.

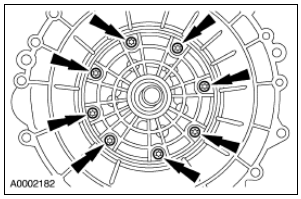


26. Remove the OD anchor strut.

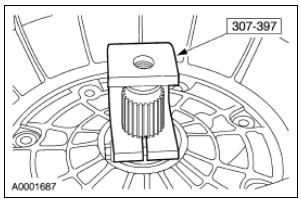


27. ⚠ **CAUTION: The screws are not reusable for assembly. Discard the screws. If the screws are reused the housing may become separated from the transmission.**

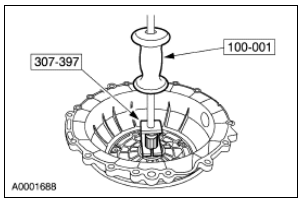
    Remove and discard the screws.



28. Install the special tool.

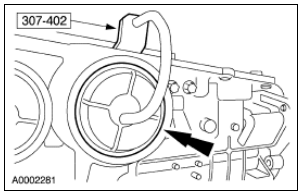


29. Using the special tools, remove the pump.

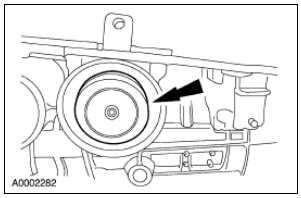


30. ⚠ **CAUTION: Servo cover is under spring tension.**

    Using the special tool, remove the intermediate servo cover retaining ring and cover.

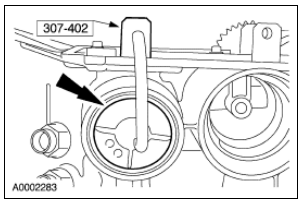


31. Remove the intermediate band servo piston and spring.

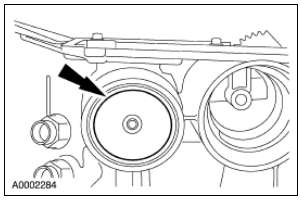


32. ⚠ **CAUTION: Servo cover is under spring tension.**

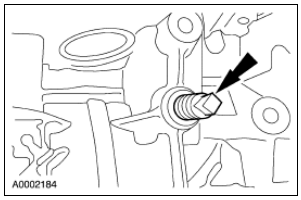
    Using the special tool, remove the overdrive servo cover retaining ring and cover.



33. Remove the front band servo piston and spring.

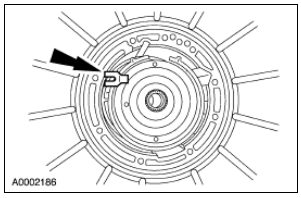


34. Remove the screw.

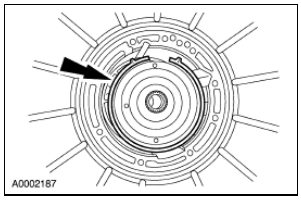


35. **NOTE:** Tag and identify parts for reassembly.

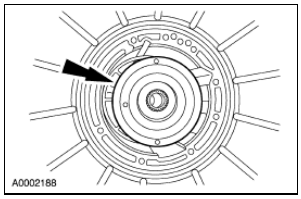
    Compress the overdrive band and remove the apply strut.



36. Remove the overdrive band.



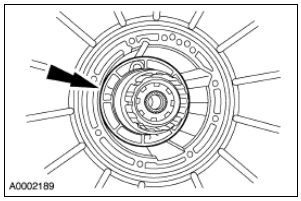
37. Remove the overdrive brake and coast clutch drum.



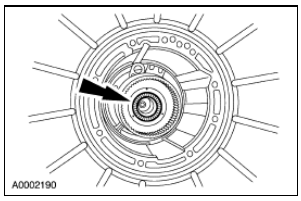
38. ⚠ **CAUTION: Do not bend trigger wheel.**

    NOTE: The No. 2 thrust bearing is in this assembly.

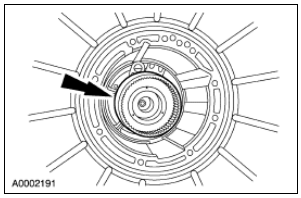
    Remove the planetary gear overdrive carrier.



39. Remove the overdrive planet thrust bearing (No. 2).

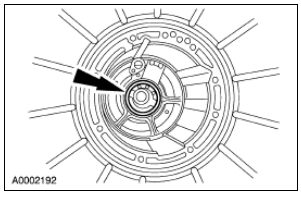


40. Remove the overdrive ring gear, overdrive one-way clutch assembly, and center shaft as an assembly.



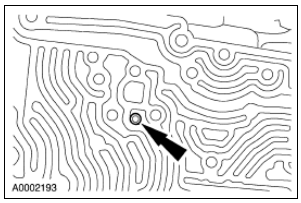
41. **NOTE:** Tag and identify the center shaft thrust bearing (No. 3) for assembly.

    Remove the No. 3 center shaft thrust bearing.

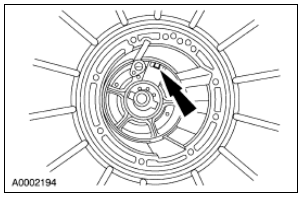


42. ⚠ **CAUTION: The center support locknut could fall into the remaining assembly if not removed.**

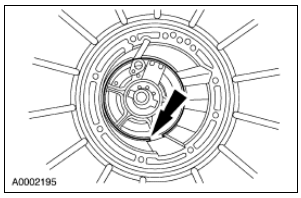
    Remove the screw.



43. Remove the locknut and cage.

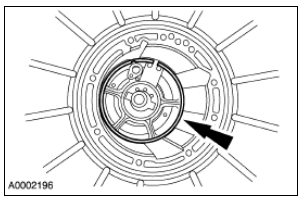


44. Remove the center support retaining ring.



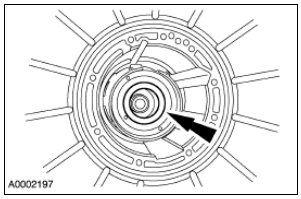
45. **NOTE:** When removing the center support, pull evenly around the center support web.

    Remove the center support.

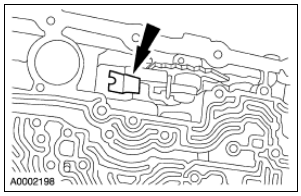


46. **NOTE:** Tag and identify the No. 4 intermediate brake drum thrust bearing.

    Remove the intermediate brake drum thrust bearing (No. 4).

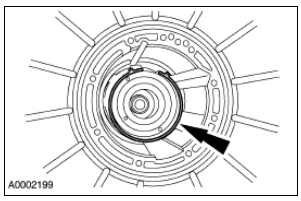


47. Remove the intermediate band anchor strut.

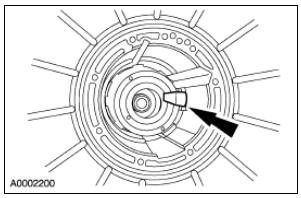


48. ⚠ **CAUTION: Identify the anchor and apply ends of the intermediate band.**

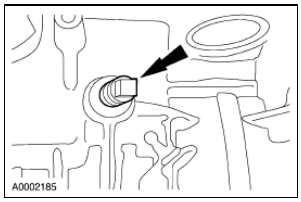
    Remove the intermediate band.



49. Remove the intermediate band apply strut.

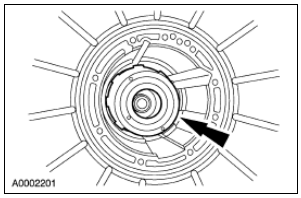


50. Remove the screw.

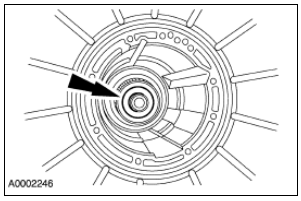


51. **NOTE:** The No. 5 forward clutch cylinder thrust bearing may come out with the intermediate brake and direct clutch drum.

    Remove the direct clutch drum.

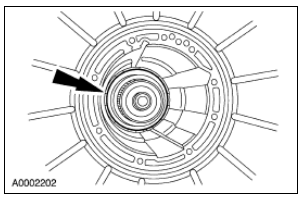


52. Remove the No. 5 forward clutch cylinder thrust bearing, tag and identify.



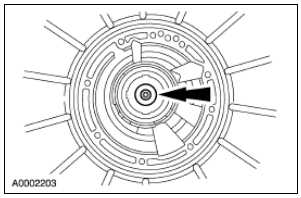
53. **NOTE:** The No. 6A thrust bearing may come out with the cylinder. Tag for reassembly.

Remove the forward clutch cylinder.



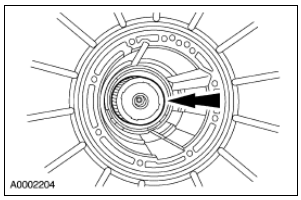
54. **NOTE:** The No. 6A forward ring gear hub thrust bearing may have come out with the forward clutch cylinder.

    Remove the No. 6A forward ring gear hub thrust bearing.

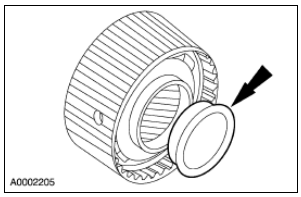


55. **NOTE:** The No. 7 forward planet thrust bearing may come out with the forward ring gear and hub assembly.

    Remove the forward ring gear and hub as an assembly.

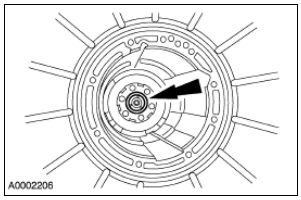


56. Remove the No. 6B forward clutch thrust washer from the forward ring gear hub.

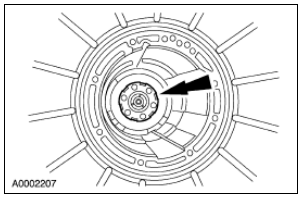


57. **NOTE:** The No. 7 forward planet thrust bearing may come out with the forward ring gear and hub assembly.

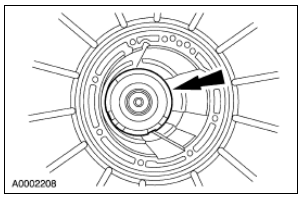
    Remove the No. 7 forward planet thrust bearing.



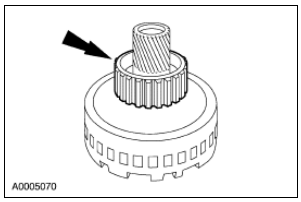
58. Remove the forward planetary assembly.



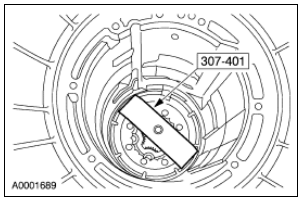
59. Remove the input shell and sun gear assembly.



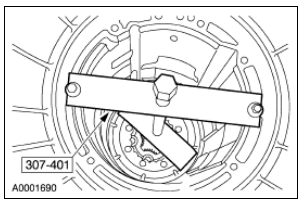
60. Rotate the intermediate one-way clutch sprag and race to disassemble.



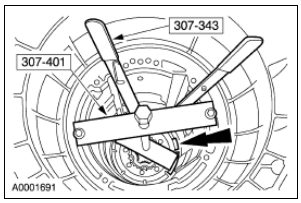
61. Install the special tool.



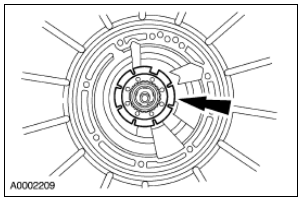
62. Install the special tool.



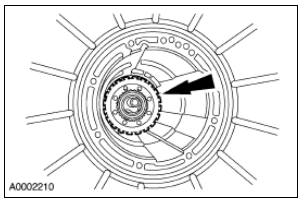
63. Using the special tools, remove the intermediate clutch retaining ring.



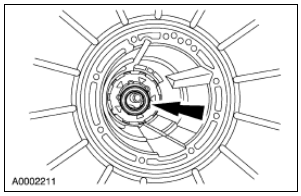
64. Remove the intermediate clutch housing and piston assembly.



65. Remove the intermediate clutch piston spring, clutch plates, and cylinder as an assembly.

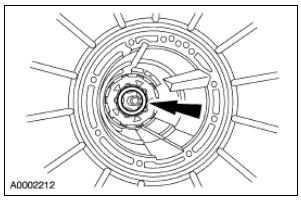


66. Remove the low and reverse gear spacer.

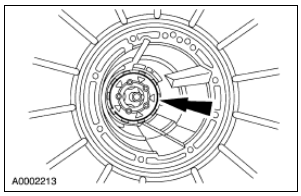


67. **NOTE:** Tag and identify the No. 8 low/reverse planetary carrier thrust bearing.

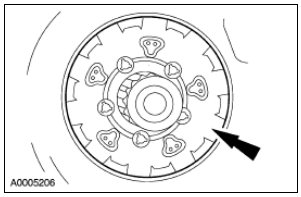
    Remove the thrust bearing.



68. Remove the retaining ring.

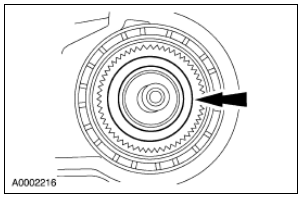


69. Remove low/reverse planetary assembly.



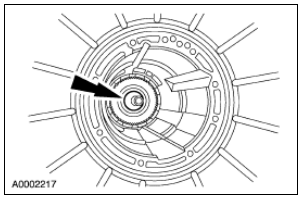
70. **NOTE:** Tag and identify the No. 9 low/reverse planetary carrier thrust bearing.

    Remove the thrust bearing.



71. **NOTE:** Use slots located around the outside of the sleeve.

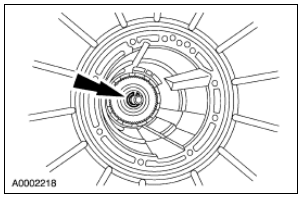
    Using a small pick, remove the output shaft sleeve.



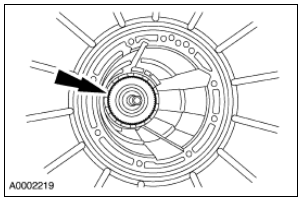
72. ⚠ **WARNING: The output shaft may fall out after removing the snap ring. Failure to follow these instructions may result in personal injury.**

    ⚠ **CAUTION: Discard the output shaft retaining ring. A new retaining ring must be used for assembly.**

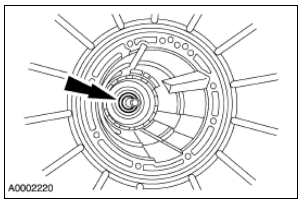
    While holding the output shaft remove and discard the output shaft retaining ring.



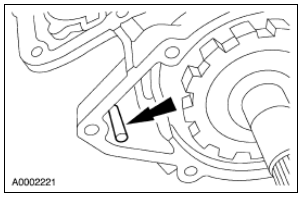
73. Remove the output shaft ring gear and hub.



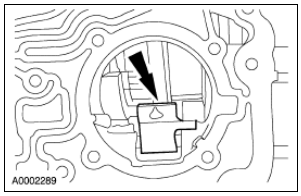
74. Remove the No. 10 low intermediate sun gear bearing.



75. Remove the reverse band actuating lever shaft.

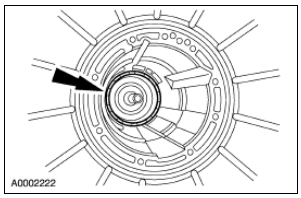


76. Remove the reverse band actuating lever assembly.

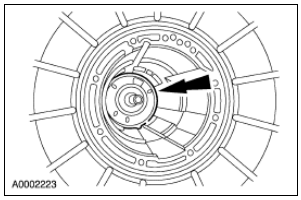


77. **NOTE:** The inner race of the rear one-way clutch is not removable. It is repaired in the case.

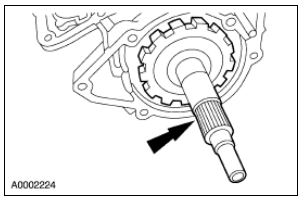
    Remove the low/reverse brake drum and one-way clutch assembly by rotating it clockwise.



78. Remove the reverse band.

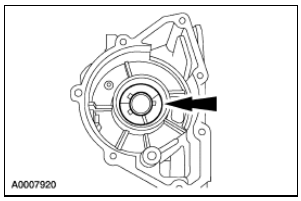


79. Remove the output shaft and park gear.



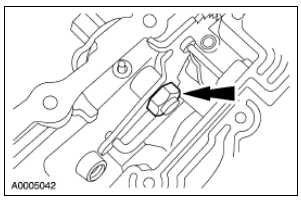
80. **NOTE:** Tag and identify the No. 11 output shaft thrust washer.

    Remove the output shaft thrust washer.

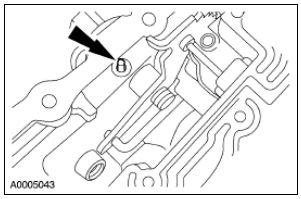


81. **⚠ CAUTION: To avoid damage, make sure the wrench does not strike the manual valve inner lever pin.**

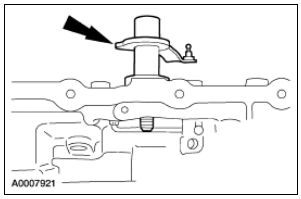
Remove the nut.



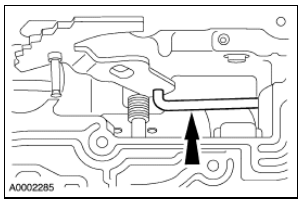
82. Remove the manual lever shaft retaining pin.



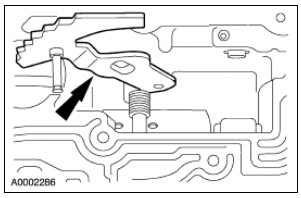
83. Remove the manual control lever shaft.



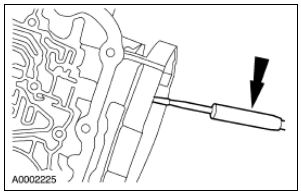
84. Disconnect the manual valve inner lever from the parking lever actuating rod.



85. Remove the manual valve inner lever.

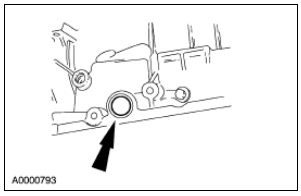


86. Remove the parking lever actuating rod.



87. ⚠ **CAUTION: Do not damage the bore.**

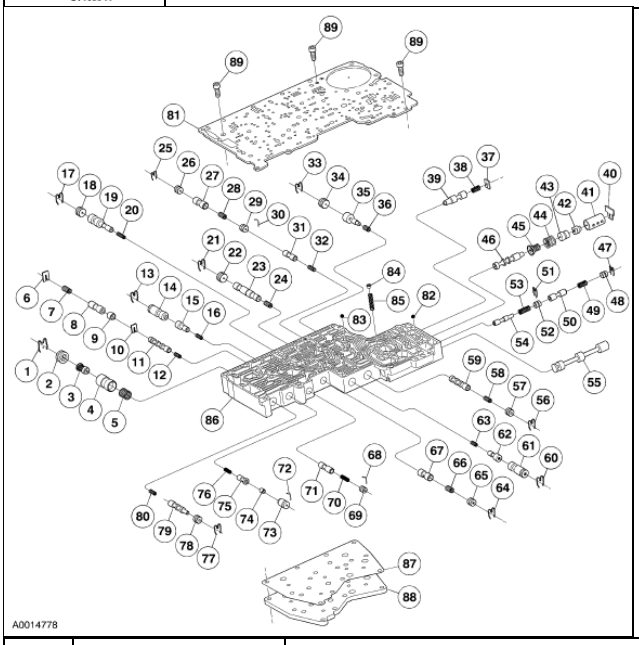
Remove the manual control lever seal.


A0000793

Main Control Valve Body

Special Tool(s)

 ST1639-A	Aligner, Valve Body 307-334 (T95L-70010-C) (2 req'd.)



Item	Part Number	Description
1	7F445	Clip retainer
2	7D374	Plug retainer
3	7M094	Valve assembly thermo
4	7L367	Valve fluid cooler bypass
5	7M116	Spring fluid cooler bypass
6	7E336	Plate
7	7G489	Spring coast clutch control
8	7G490	Valve coast clutch control
9	7G490	Valve coast clutch control
10	7E336	Plate
11	7M189	Valve overdrive servo control
12	7M193	Spring overdrive servo control valve
13	7M445	Clip retainer
14	7D374	Plug retainer
15	7M095	Valve modulator
16	7M104	Spring modulator valve
17	7F445	Plug retainer
18	7D374	Clip retainer

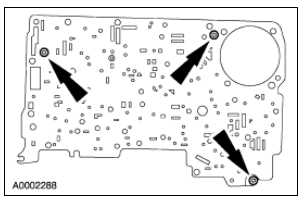
19	7F259	Valve 4-3 ISR downshift control
20	7F260	Spring 4-3 ISR control valve
21	7F445	Plug retainer
22	7D374	Clip retainer
23	7M188	Valve 4-3 pre-stroke intermediate band control
24	7G289	Spring 4-3 pre-stroke intermediate band control valve
25	7F445	Clip retainer
26	7D374	Plug retainer
27	7G317	Valve reverse engagement
28	7D312	Spring reverse engagement valve
29	7D374	Plug retainer
30	7D335	Retainer wire
31	7M187	Valve high clutch control
32	7M192	Spring high clutch control valve
33	7F445	Clip retainer
34	7D374	Plug retainer
35	7M095	Valve reverse modulator
36	7M104	Spring reverse modulator valve
37	7E336	Plate
38	7M191	Spring rear servo control valve
39	7M098	Valve rear servo control
40	7E336	Plate
41	7D002	Sleeve
42	7D003	Valve booster
43	7D003	Valve booster
44	7A270	Spring outer
45	7H149	Spring and retainer assembly
46	7C388	Valve main regulator
47	7F445	Retainer clip
48	7D374	Retainer plug
49	7L317	Spring reverse inhibition valve
50	7L316	Valve reverse inhibition
51	7E445	Retainer clip
52	7D374	Retainer plug
53	7G411	Spring solenoid regulator valve
54	7G473	Valve solenoid regulator
55	7340	Valve manual
56	7F445	Retainer clip
57	7D374	Retainer plug
58	7M099	Spring select valve
59	7M186	Spring select
60	7F445	Retainer clip
61	7D374	Retainer plug

62	7M095	Valve modulator
63	7M104	Spring modulator valve
64	7F445	Retainer clip
65	7D374	Retainer plug
66	7G312	Spring forward engagement control valve
67	7D317	Valve forward engagement control
68	7E335	Retainer wire
69	7D374	Retainer plug
70	7M190	Spring back pressure
71	7M185	Valve converter clutch back pressure
72	7E335	Retainer wire
73	7D002	Sleeve converter clutch modulator control
74	7M184	Valve converter clutch modulator control
75	7G307	Valve converter clutch modulator
76	7G316	Spring converter clutch modulator control
77	7F445	Retainer clip
78	7D374	Retainer plug
79	7L318	Valve converter clutch control
80	7L490	Spring converter clutch control valve
81	7Z490	Plate assembly main control valve body separator
82	7E195	Ball lubrication check
83	7E195	Ball shuttle valve
84	7E368	Valve limit
85	7E340	Spring limit valve
86	7A101	Body control valve lower
87	7H173	Gasket valve body cover plate
88	7C034	Plate valve body cover
89	W701099-S1430	Screw separator plate

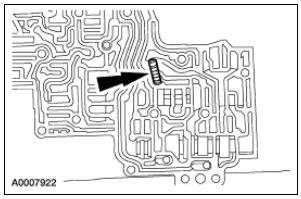
Disassembly

1. **NOTE:** The valve body separator plate has a bonded gasket.

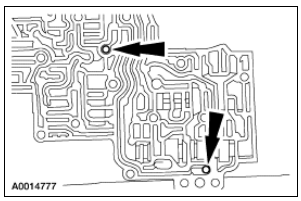
   Remove the valve body separator plate.



2. Remove the pressure control limit relief valve and spring.



3. Remove the check balls.



4. **NOTE:** Refer to the disassembled view.

   Disassemble the main control valve body.

Assembly

1. ⚠ **CAUTION: Do not lose parts when cleaning or repairing.**

   Thoroughly clean all parts in solvent and blow dry with moisture-free compressed air.

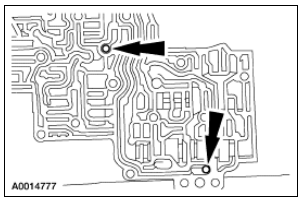
2. ⚠ **CAUTION: Do not stone, file, or sand the valves. This will remove the anodized finish and may result in further main control or transmission damage.**

   After cleaning the main control valve body, carry out the following.

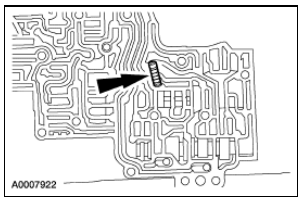
   - Inspect all valve and plug bores for scoring or burrs.
   - Check all fluid passages for obstructions.
   - Inspect all valves and plugs for burrs.
   - Inspect all mating surfaces for burrs or distortion.
   - Inspect all springs for distortion.
   - Check all valves and plugs for free movement in their respective bores.
     - ♦ Valves and plugs, when dry, must fall from their own weight into their respective bores.
   - Roll the manual valve on a flat surface to check for a bent condition.

3. Assemble the main control valve body.

4. Install the main control valve body check balls.

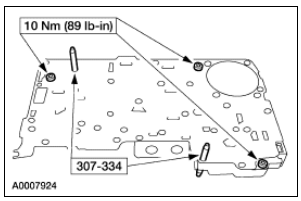


5. Install the pressure control limit relief valve and spring.



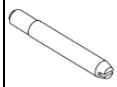
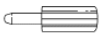
6. **NOTE:** Use a new valve body separator plate for main control valve body installation.

Using the special tools, install the main control valve body separator plate.



Fluid Pump

Special Tool(s)

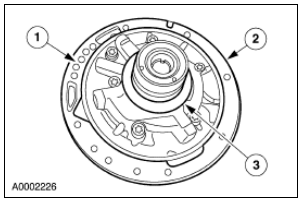
 ST1833-A	Installer, Torque Converter Fluid Seal 307-349 (T97T-77000-A)
 ST1817-A	Alignment Set, Fluid Pump 307-S039 (T74P-77103-X)
 ST2532-A	Alignment Gauge, Transmission Fluid Pump 307-431
 ST2533-A	Alignment Gauge, Transmission Fluid Pump 307-432
 ST1826-A	Sizer, Piston Seal 307-338 (T95L-70010-G)
 ST2419-A	Alignment Pins, Transmission Fluid Pump 307-398
 ST2684-A	Transmission Fluid Pump Seal Aligner 307-451/1
 ST2685-A	Transmission Fluid Pump Seal Sizer 307-451/2
 ST2686-A	Transmission Fluid Pump Seal Installer 307-451/3

Material

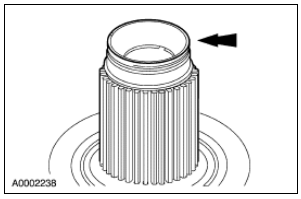
Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM	MERCON® V

Disassembly

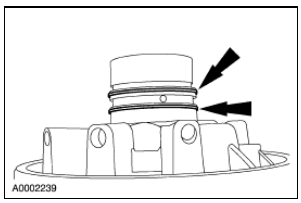
1. Remove the fluid pump gasket, fluid pump seal ring, and the No.1 thrust washer.
    1. Remove and discard the fluid pump gasket.
    2. Remove and discard the fluid pump seal ring (square cut).
    3. Remove and tag the No.1 thrust washer.



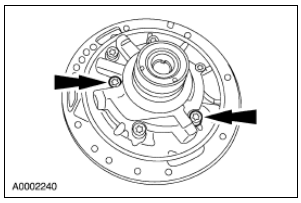
2. Remove the fluid pump support seal ring.



3. Remove the seal rings.



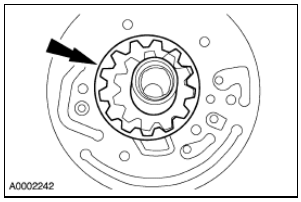
4. Remove the fluid pump housing.



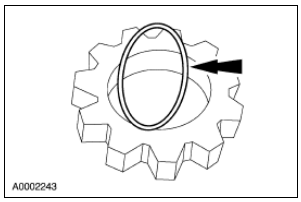
5. **NOTE:** A rough casting on the pump surface crescent is not a flaw.

   NOTE: The fluid pump gears are part of the pump assembly and are not repaired separately.

   Remove the fluid pump gears.

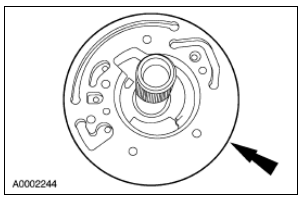


6. Remove the drive gear O-ring seal and discard. Inspect the fluid pump gears for cracks and scoring.

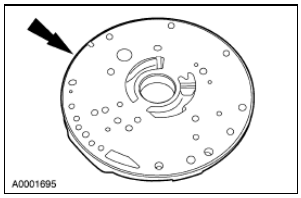


7. Inspect the overdrive pump.
   - Inspect the overdrive pump support gear pockets for scoring and wear.

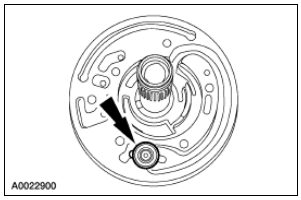
- Clean and inspect the overdrive and rear input shaft bushings.



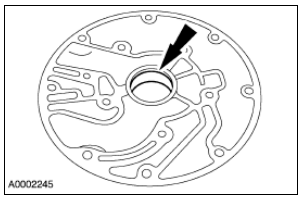
8. Inspect the fluid pump adapter plate for scoring and wear.



9. Remove the valve.



10. Inspect the fluid pump to converter housing bushing.



Assembly

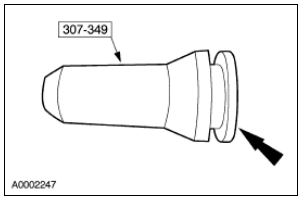
1. **NOTE:** Minor burrs and scoring may be removed with crocus cloth. If damage is found, install a new assembly.

   Inspect the fluid pump components for the following:

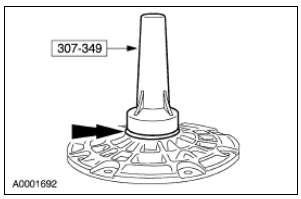
   - Pump body and case for burrs.
   - Fluid passages for obstructions.

2. **NOTE:** Check and make sure that the garter spring in the seal has not popped off of the converter hub seal.

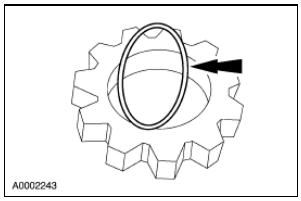
   Install a new seal onto the special tool.



3. Using the special tool, install the converter hub seal.

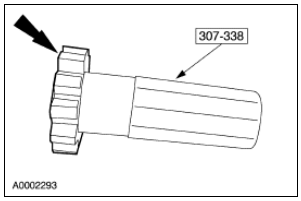


4. Install a new O-ring seal in fluid pump drive gear.



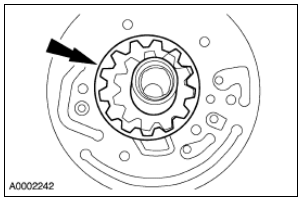
5. ⚠ **CAUTION: Lubricate the special tool with multi-purpose grease.**

   Using the special tool, seat the O-ring seal in the pump gear.

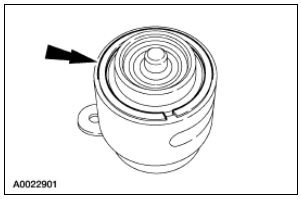


6. ⚠ **CAUTION: The chamber on the inside edge of the small gear must be up when in the pump housing gear pocket. The dimple on the larger gear must be down when in the pump housing gear pocket.**

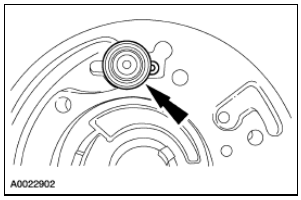
   Install the pump gears into the fluid pump housing. Apply multi-purpose grease to pump gear to prevent scoring at start-up.



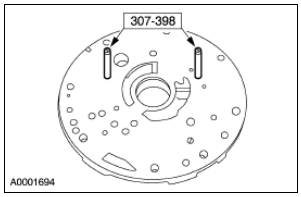
7. Install a new seal on the valve.



8. Install the valve.

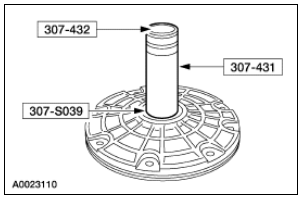


9. First install the fluid pump adapter plate and then the alignment pins in their correct locations.

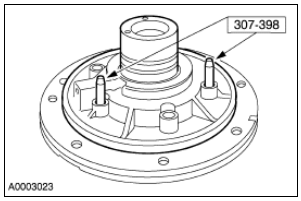


10. ⚠ **CAUTION: The special tools must be used to correctly align the pump with the adapter plate to reduce gear noise, bushing failure and leakage.**

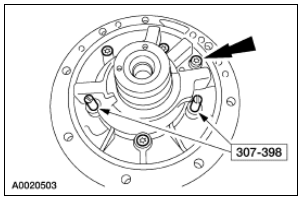
    Using the special tool, align the fluid pump to the adapter plate.



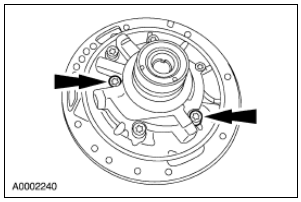
11. Using the special tools, assemble the pump.



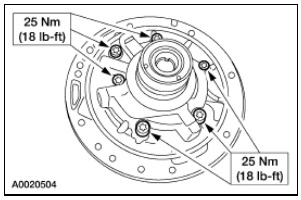
12. Loosely install the fluid pump housing screws in their correct locations and remove the special tools.



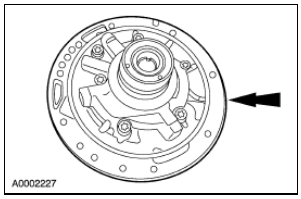
13. Install the two remaining screws.



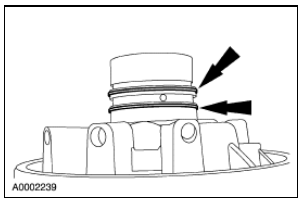
14. Tighten all of the fluid pump screws in a star pattern.



15. Install a new fluid pump seal ring.

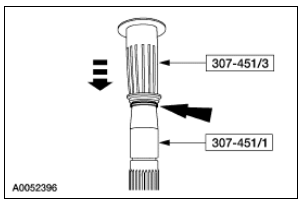


16. Install new seal rings.



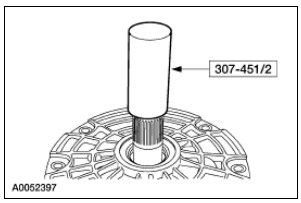
17. **⚠ CAUTION: Be careful not to overstretch the seal ring past the seal ring groove. Damage to the seal will occur.**

    Using the special tools, install the fluid pump seal ring.



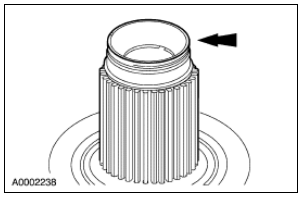
18. **⚠ CAUTION: Failure to correctly size the seal will damage the seal when the torque converter is installed.**

    Using the special tool, size the seal to the correct size. Leave the special tool on the seal for two minutes to obtain the correct seal size.



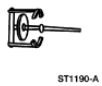
19. **⚠ CAUTION: Verify correct seal installation. Make sure seal grooves are clean and free of burrs.**

    Install the seal.


A0002238

Overdrive Brake and Coast Clutch Drum Assembly

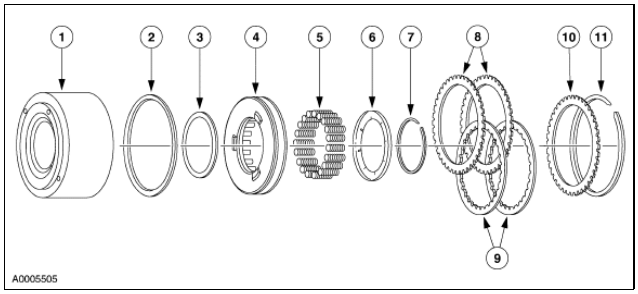
Special Tool(s)

 ST1190-A	Compressor, Clutch Spring 307-015 (T65L-77515-A)
 ST2431-A	Protector, Piston Seal 307-049 (T74P-77404-A)

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

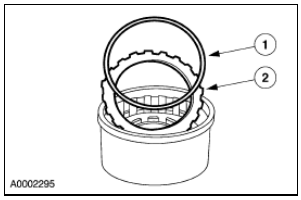
Overdrive Brake and Coast Clutch Drum Assembly



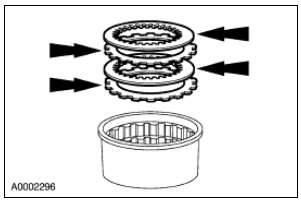
Item	Part Number	Description
1	7L669	Overdrive brake and coast clutch drum
2	7A548	Direct and overdrive piston outer seal ring
3	7D404	Direct and overdrive piston inner seal ring
4	7A262	Direct and overdrive clutch piston
5	7A480	Direct and overdrive piston spring (20 req'd)
6	7A527	Direct/coast clutch piston spring retainer
7	E860125-S	Retaining ring
8	7B442	Coast clutch external plate steel (2 Req'd)
9	7B164	Coast clutch internal plate friction (2 Req'd)
10	7B066	Direct/coast clutch pressure plate
11	E860126S/129S	Retaining ring (select fit)

Disassembly

1. Remove the coast clutch pressure plate.
    1. Remove the coast clutch retaining ring.
    2. Remove the coast clutch pressure plate.



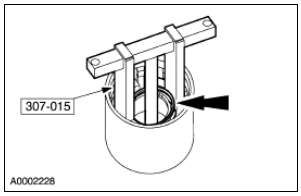
2. Remove the coast clutch disc pack.
    - Inspect for wear, install a new pack as necessary.



3. **⚠ WARNING: Use caution when releasing tool pressure on the rear clutch piston spring. Failure to follow these instructions may result in personal injury.**

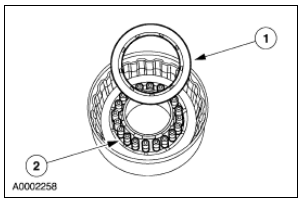
   ⚠ CAUTION: Do not fully compress the special tool or damage to the spring retainer may occur.

   Using the special tool, remove the coast clutch piston retaining ring.



4. Relieve the coast clutch spring tension and remove the special tool.

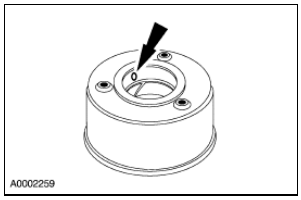
5. Remove the coast clutch piston springs.
    1. Remove the coast clutch piston retainer.
    2. Remove the clutch piston springs.



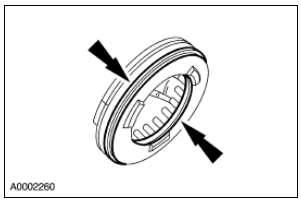
6. **⚠ WARNING: Air pressure must not exceed 138 kPa (20 psi). Wear safety glasses when using compressed air, and make sure the drum is facing down as shown. Failure to follow these instructions may result in personal injury.**

   Remove the coast clutch piston.

    - Apply air pressure to the hole in the drum to remove the coast clutch piston while blocking the other hole with a finger.



7. Remove the coast clutch piston inner seal and the coast clutch piston outer seal.
    - Clean and install a new seal as necessary.

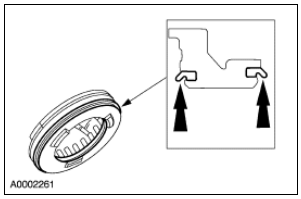


Assembly

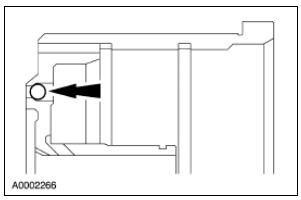
1. Inspect the coast clutch components for damage or wear. Install new components as necessary.
    - Inspect the drum band surface, bushing, and thrust surfaces for damage.
    - Inspect the clutch piston bore, and piston.
    - Check the fluid passages for obstructions. All fluid passages must be clean and free of obstructions.
    - Inspect the clutch plates for damage.
    - Inspect the clutch springs.

2. ⚠ **CAUTION: The lip seals must be positioned as shown. Care must be taken to prevent rollover of the lip seal.**

    Install the new coast clutch piston inner and outer seal.

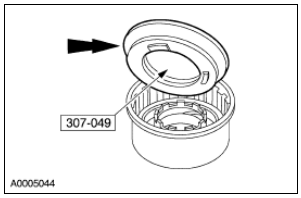


3. Verify the check ball is free to move.

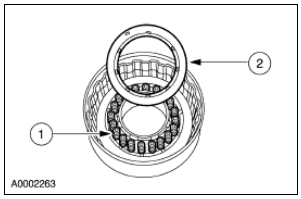


4. ⚠ **CAUTION: Care must be taken to prevent damage to the seals during installation.**

    Using the special tool, install the coast clutch piston.

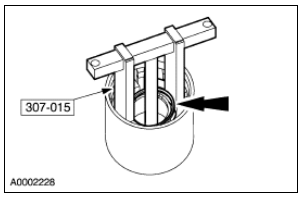


5. Install the coast clutch piston springs.
    1. Install the coast clutch piston springs.
    2. Install the coast clutch spring retainer.



6. **⚠ CAUTION: Do not fully compress the special tool or damage to the coast clutch piston spring retainer may occur.**

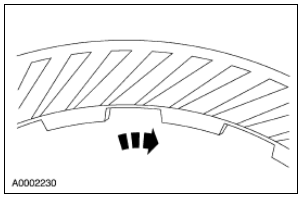
    Using the special tool, install the coast clutch piston spring retainer ring.



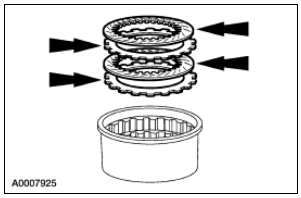
7. **⚠ CAUTION: Coast clutch friction plates are directional and must be installed with grooves clockwise (I.D. to O.D.). The word "TOP" should face up.**

    ⚠ CAUTION: If new clutch plates are being used, they should be soaked in clean automatic transmission fluid for at least 30 minutes before assembly.

    When installing friction plates, the word "TOP" should face up. If reusing plates, grooves must be installed clockwise. Install the coast clutch disc pack.



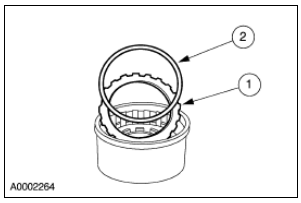
8. Install the two steel clutch plates and two friction clutch plates in alternating order starting with a steel clutch plate.



9. **⚠ CAUTION: The retaining ring is select fit.**

Install the coast clutch pressure plate.

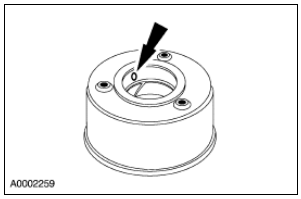
1. Install the coast clutch pressure plate.
2. Install the original coast clutch retaining ring.



10. ⚠ **WARNING: Air pressure must not exceed 138 kPa (20 psi). Wear safety glasses when using compressed air, and make sure drum is facing down as shown. Failure to follow these instructions may result in personal injury.**

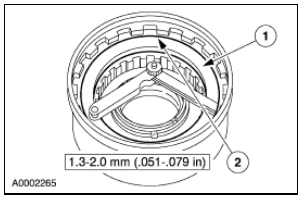
    Air check the assembly.

    - Apply air pressure to the hole in the drum while blocking the other hole with a finger.



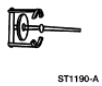
11. Check the coast clutch disc pack free play.
    1. Push down on the coast pressure plate.
    2. Check clearance between the coast clutch retaining ring and coast pressure plate. Clearance should be 1.3-2.0 mm (.051-.079 in). If clearance is not within the specification, install a correct coast clutch retaining ring that will provide the correct free play adjustment.

Part Number	Thickness		Diameter	
	mm	In	mm	In
E860126-S	1.37	.0539	130.1	5.122
E860127-S	1.73	.0681	130.1	5.122
E860128-S	2.08	.0819	130.1	5.122
E860129-S	2.44	.0961	130.1	5.122



Direct Clutch Drum Assembly

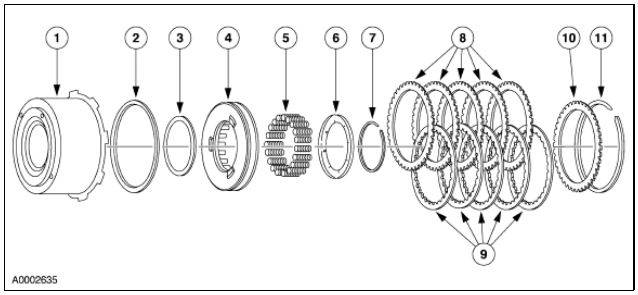
Special Tool(s)

 ST1190-A	Compressor, Clutch Spring 307-015 (T65L-77515-A)
 ST2431-A	Protector, Piston Seal 307-049 (T74P-77404-A)

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

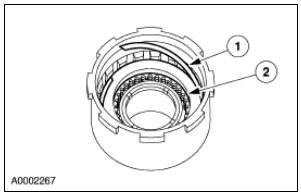
Direct Clutch Drum Assembly



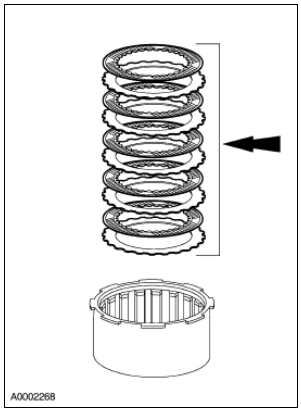
Item	Part Number	Description
1	7D044	Intermediate brake drum assembly
2	7A548	Direct and overdrive piston outer seal ring
3	7D404	Direct and overdrive piston inner seal ring
4	7A262	Direct and overdrive clutch piston
5	7A480	Direct and overdrive piston spring (20 req'd)
6	7A527	Direct/coast clutch piston spring retainer
7	E860125-S	Retaining ring
8	7B442	Direct clutch external spline plate
9	7B164	Direct clutch internal spline plate
10	7B066	Direct/coast clutch pressure plate
11	E860126S/129S	Retaining ring (select fit)

Disassembly

1. Remove the direct clutch retaining ring and the direct clutch pressure plate.
    1. Remove the direct clutch retaining ring.
    2. Remove the direct clutch pressure plate.



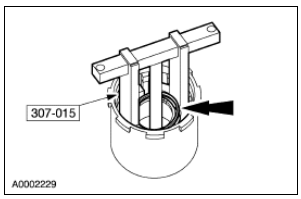
2. Remove the direct clutch disc pack.
    - Inspect and install new friction plates if worn, damaged, or overheated.



3. **⚠ WARNING: After removing the retaining ring, use care when releasing the pressure on the springs. Failure to follow these instructions may result in personal injury.**

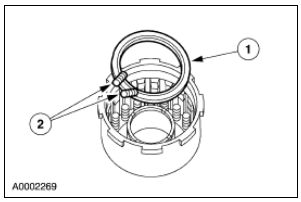
   ⚠ CAUTION: Do not fully compress the special tool or damage to the spring retainer may occur.

   Using the special tool, remove the direct clutch piston retaining ring.



4. Relieve the direct clutch spring tension and remove the special tool.

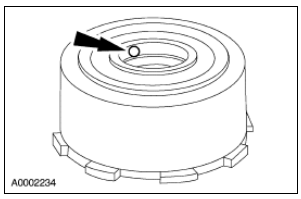
5. Remove the direct clutch piston spring retainer and the direct clutch piston springs.
    1. Remove the direct clutch piston spring retainer.
    2. Remove the direct clutch piston springs.



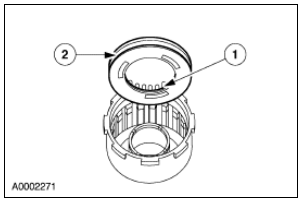
6. **⚠ WARNING: Air pressure must not exceed 138 kPa (20 psi). Wear safety glasses when using compressed air, and make sure the drum is facing down as shown. Failure to follow these instructions may result in personal injury.**

   Using compressed air, remove the direct clutch piston from the direct clutch drum.

- Apply air pressure to the hole in the drum while blocking the other hole with a finger.



7. Remove the direct clutch piston inner and outer seal.
    1. Remove the direct clutch piston inner seal.
    2. Remove the direct clutch piston outer seal.
    - Clean and install new components as necessary.



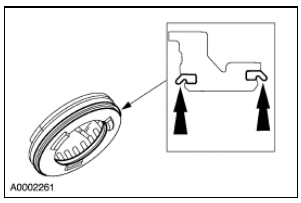
Assembly

1. Inspect the clutch components for damage or wear. Install new components as necessary.
    - Inspect the drum surface for damage.
    - Inspect the clutch piston bore, and piston.
    - Check the fluid passages for obstructions. All fluid passages must be clean and free of obstructions.
    - Inspect the clutch plates for damage.
    - Inspect the clutch springs.

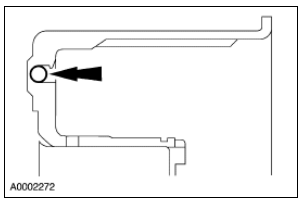
2. ⚠ **CAUTION: The lip seals must be positioned as shown. Care must be taken to prevent rollover of the lip seal.**

    NOTE: Use new seals to help prevent seal failures.

    Install the new direct clutch piston inner seal and the direct clutch piston outer seal.

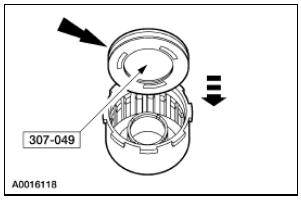


3. Verify the check ball is free to move.

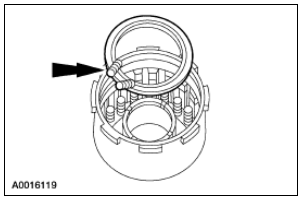


4. ⚠ **CAUTION: Care must be taken to prevent damage to the seals during installation.**

    Using the special tool, install the direct clutch piston.



5. Install the direct clutch piston springs and the retainer.

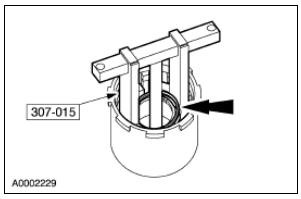


6. Relieve the direct clutch spring tension and remove the special tool.

7. **⚠ WARNING: After removing the retaining ring, use care when releasing the pressure on the springs. Failure to follow these instructions may result in personal injury.**

   ⚠ CAUTION: Do not fully compress the special tool or damage to the spring retainer may occur.

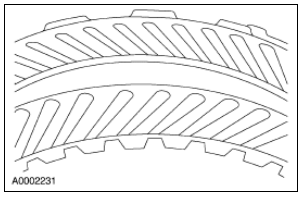
   Using the special tool, install the direct clutch piston retaining ring.



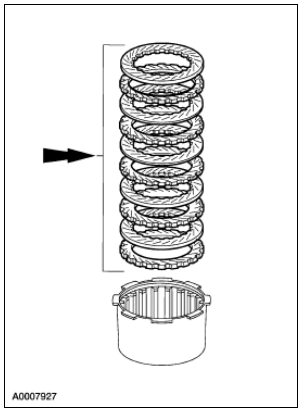
8. **⚠ CAUTION: The direct clutch friction plates are directional and must be installed correctly. Alternate the internally splined (clockwise) and the externally splined (counterclockwise) clutch plates.**

   ⚠ CAUTION: If new plates are used, they should be soaked in clean automatic transmission fluid for at least 30 minutes before assembly.

   When installing friction plates, alternate the internally splined (clockwise) and the externally splined (counterclockwise) clutch plates. Install the direct clutch disc pack.

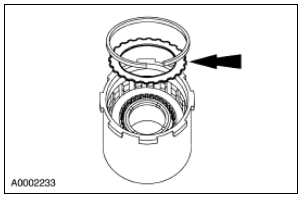


9. Install the friction plates alternating the internally splined (clockwise) and the externally splined (counterclockwise) clutch plates starting with an externally splined (counterclockwise) clutch plate.



10. ⚠ **CAUTION: The retaining ring is a select fit.**

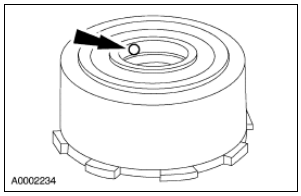
    Install the direct clutch pressure plate using the original direct clutch retaining ring.



11. ⚠ **WARNING: Air pressure must not exceed 138 kPa (20 psi). Wear safety glasses when using compressed air, and make sure drum is facing down as shown. Failure to follow these instructions may result in personal injury.**

    Air check the assembly.

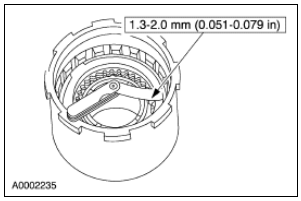
    - Apply air pressure to the hole in the drum while blocking the other hole with a finger.



12. Push down on direct clutch disc pack and check gap between the direct clutch retaining ring and the direct clutch pressure plate with a feeler gauge.
    - If specifications do not match use a select fit direct clutch retaining ring to match specifications and verify with a feeler gauge.

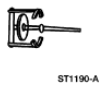
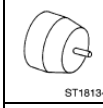
    Direct Clutch

Part Number	Thickness		Diameter	
	mm	In	mm	In
E860126-S	1.37	0.0539	130.1	5.122
E860127-S	1.73	0.0681	130.1	5.122
E860128-S	2.08	0.0819	130.1	5.122
E860129-S	2.44	0.0961	130.1	5.122


1.3-2.0 mm (0.051-0.079 in)
A0002235

Forward Clutch Bonded Piston

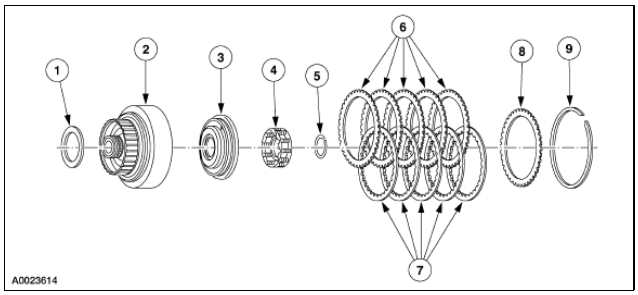
Special Tool(s)

 ST1190-A	Compressor, Clutch Spring 307-015 (T65L-77515-A)
 ST1813-A	Protector, Piston Seal 307-051 (T74P-77548-A)
 ST2534-A	Gauge, Forward Clutch Seal 307-434

Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON®

Forward Clutch Assembly

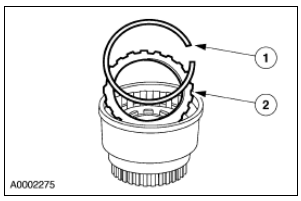


Item	Part Number	Description
1	7M153	Forward clutch cylinder thrust bearing (No. 5)
2	7A360	Forward clutch cylinder assembly
3	7A262	Forward clutch piston
4	7G229	Forward clutch cushion spring
5	E860109-S	Forward clutch retaining ring
6	7B442	Forward clutch external plate-steel (vehicle-dependent)
7	7B164	Forward clutch internal plate-friction (vehicle-dependent)
8	7B066	Forward clutch pressure plate
9	7D483	Forward clutch retaining ring (select fit)

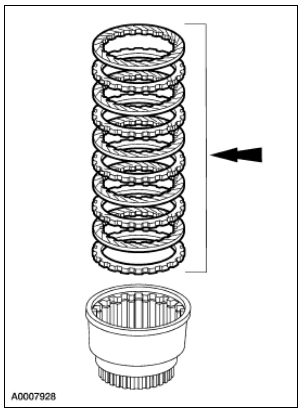
Disassembly

1. Remove the pressure plate.
    1. Remove the forward clutch retaining ring.

2. Remove the pressure plate.



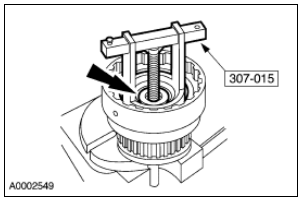
2. Remove the forward clutch disc pack.
   - Inspect the forward clutch plates for wear, damage or overheating.



3. **⚠ WARNING: Use caution when releasing tool pressure on the clutch piston springs. Failure to follow these instructions may result in personal injury.**

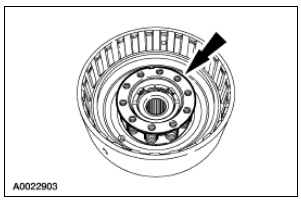
   ⚠ CAUTION: Do not fully depress the special tool or damage to the spring retainer may occur.

   Using the special tool, remove the forward clutch piston retaining ring.



4. Relieve the forward clutch spring tension and remove the tool.

5. Remove the forward clutch piston spring assembly.

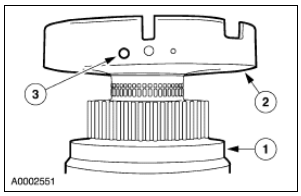


6. **⚠ WARNING: Air pressure must not exceed 138 kPa (20 psi). Wear safety glasses when using compressed air. Make sure the cylinder is facing down as shown. Failure to follow these instructions may result in personal injury.**

   Remove the forward clutch piston.

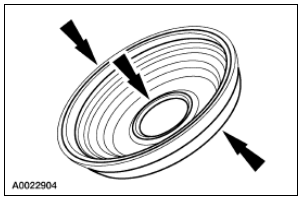
   1. Place the forward clutch cylinder with forward clutch piston facing down.

2. Install the center support on the forward clutch cylinder.
3. Apply air pressure to the left port of the center support.

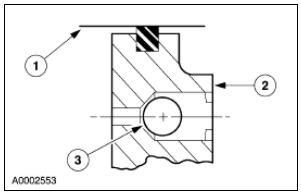


7. **NOTE:** If the seals on the forward clutch piston show any signs of damage the forward clutch piston will need to be replaced.

   Inspect the forward clutch piston, and seals.



8. Inspect the forward clutch drum assembly.
   1. Inspect the forward clutch cylinder surfaces for scores or burrs.
   2. Inspect forward clutch piston for scores or burrs.
   3. Verify the check ball is free to move in the piston.

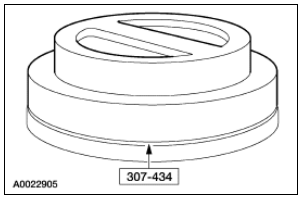


Assembly

1. Inspect the clutch components for damage or wear. Install new components as necessary.
   - Check the fluid passages for obstructions. All fluid passages must be clean and free of obstructions.
   - Inspect the clutch plates for damage.
   - Inspect the clutch springs.
   - Inspect the needle bearing and seal rings for damage.
   - Check clutch hub thrust surfaces for damage.
   - Check clutch plates for flatness and fit on the clutch hub serrations.

2. **NOTE:** The special tool needs to be installed on the forward clutch piston for a couple of minutes prior to installing it into the forward clutch cylinder.

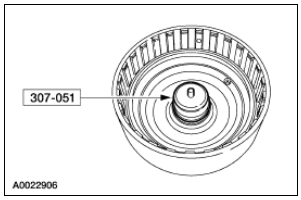
   Install the special tool on the forward clutch piston.



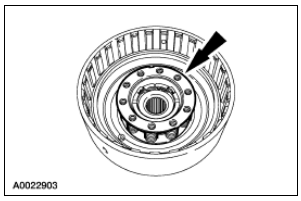
3. ⚠ **CAUTION: Care must be taken to prevent damage to the seals.**

   NOTE: Lubricate the forward clutch piston inner and outer seal with clean automatic transmission fluid.

   Using the special tool, install the forward clutch piston assembly into the forward clutch cylinder.

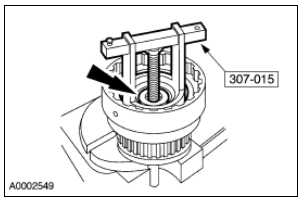


4. Install the forward clutch piston spring assembly.



5. ⚠ **CAUTION: Do not fully depress the clutch spring compressor or damage to the spring retainer may occur.**

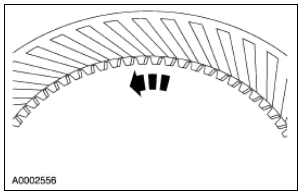
   Using the special tool, install the forward clutch piston spring retaining ring.



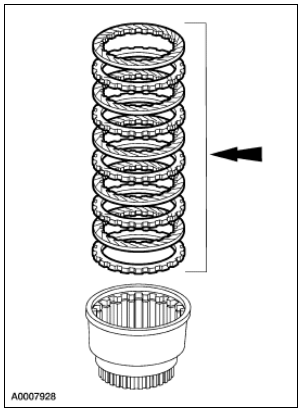
6. ⚠ **CAUTION: The forward clutch friction plates are directional and must be installed with grooves pointing counterclockwise.**

   ⚠ **CAUTION: If new plates are used, they should be soaked in clean automatic transmission fluid for at least 30 minutes before assembly.**

   If reusing plates, grooves must be installed counterclockwise. Install the direct clutch disc pack.



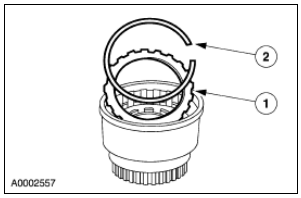
7. Install the steel clutch plates and friction clutch plates in alternating order starting with a steel clutch plate.



8. ⚠ **CAUTION: The retaining ring is a select fit.**

   Install the original selective retaining ring.

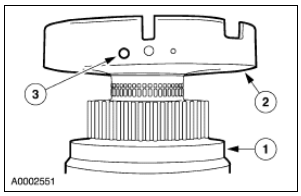
   1. Install the forward clutch pressure plate.
   2. Install the original selective retaining ring.



9. ⚠ **WARNING: Air pressure must not exceed 138 kPa (20 psi). Wear safety glasses when using compressed air. Make sure the cylinder is facing down as shown. Failure to follow these instructions may result in personal injury.**

   Air check the forward clutch piston.

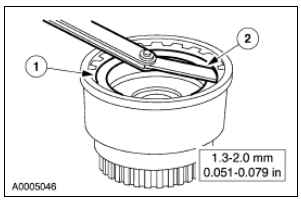
   1. Place the forward clutch cylinder with forward clutch piston facing down.
   2. Install the transmission center support on the forward clutch cylinder.
   3. Apply air pressure to the left port of the center support.



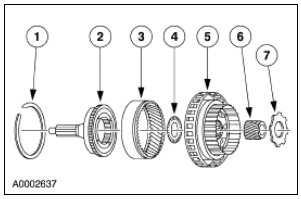
10. Check forward clutch disc pack free play.
    1. Press down on forward clutch disc pack.
    2. Using a feeler gauge, check the gap between the forward clutch retaining ring and the forward clutch pressure plate.

    • If the clearance is not within specifications, install the correct size retaining ring.

Part Number	Thickness		Diameter	
	mm	In	mm	In
XW4Z-7D483-AB	1.73	0.0681	141.45	5.65 in
XW4Z-7D483-AC	2.08	0.0819	141.45	5.65 in
XW4Z-7D483-AD	2.44	0.0961	141.45	5.65 in


1
2
1.3-2.0 mm
0.051-0.079 in
A0005046

Overdrive Planetary and One-Way Clutch Assembly



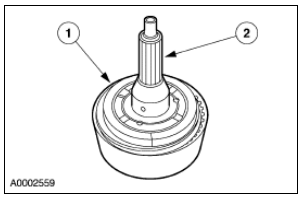
Item	Part Number	Description
1	W702037-S300	Retaining ring
2	7A658	Center shaft
3	7653	Overdrive ring gear
4	7L495	No. 2 overdrive planetary thrust bearing
5	7B446	Overdrive planetary gear carrier assembly
6	7D063	Overdrive sun gear
7	7660	Coast clutch adapter

Disassembly

1. **NOTE:** The overdrive one-way clutch is serviced with the center shaft assembly.

   Remove the center shaft from the overdrive ring gear.

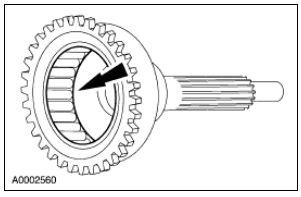
   1. Remove the overdrive center shaft retaining ring.
   2. While rotating counterclockwise remove the center shaft from the ring gear.



2. ⚠ **CAUTION: Do not remove the overdrive one-way clutch. Damage to the clutch may occur if it is removed.**

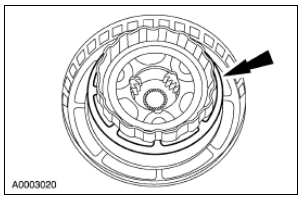
   Clean and inspect the overdrive one-way clutch and center shaft.

   - Inspect for cracks in the roller cage and wear on the roller clutch, and the press fit of the one-way clutch to the center shaft.



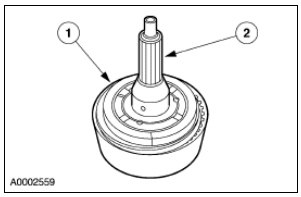
3. Inspect the one-way clutch.
   - Temporarily insert the overdrive planetary gear carrier assembly into the one-way clutch rollers for verification of the one-way clutch.

- The planetary gear must rotate counterclockwise and hold when rotated clockwise.
- Remove the planetary gear carrier assembly.



Assembly

1. Install the center shaft and one-way clutch.
    1. Install the center shaft and one-way clutch.
    2. Install the center shaft retaining ring.



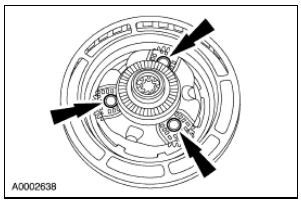
Overdrive Planetary Gears

Disassembly

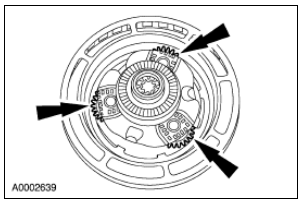
1. ⚠ **CAUTION: New planetary gears must be installed. Do not restake the originals.**

   NOTE: Individual parts of the planetary carriers are not serviceable.

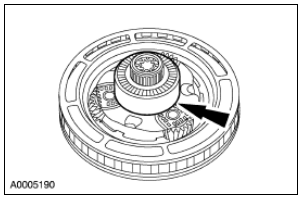
   Before installing a planetary assembly, the shaft retaining pins should be checked for adequate staking. Check the pins and shafts in the planetary assemblies for loose fit and/or complete disengagement. Install a new planetary assembly if necessary.



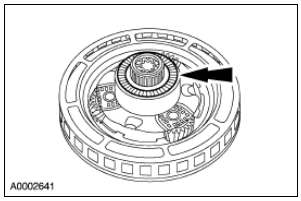
2. Inspect the pinion gears for damaged or excessively worn teeth, and for free rotation.



3. Inspect the overdrive one-way clutch inner race, and the inner and outer races for scored or damaged surface areas where the rollers contact the races.

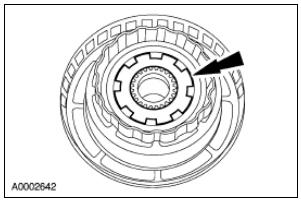


4. Remove and inspect the No. 2 overdrive planetary thrust bearing on the nose of the overdrive planetary gear carrier assembly.

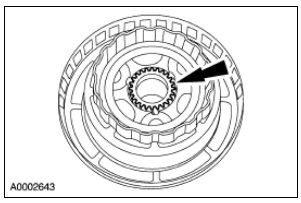


5. **NOTE:** Inspect the sun gear for damaged or worn teeth.

   Remove the coast clutch-to-overdrive carrier adapter.

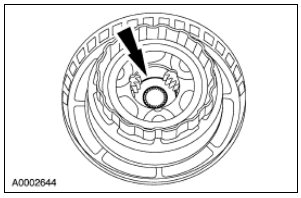


6. Remove the overdrive sun gear.



7. ⚠ **CAUTION: Do not attempt to remove the No. 12 bearing from behind the pinion gears.**

   Inspect the No. 12 bearing for damage.

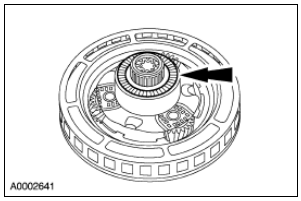


Assembly

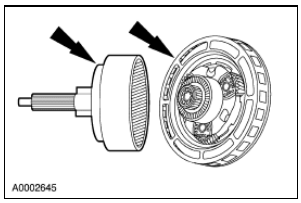
1. **NOTE:** Thoroughly clean all parts and blow dry with moisture-free compressed air.

   NOTE: Use petroleum jelly to hold the No. 2 overdrive planetary thrust bearing in place.

   Install the No. 2 overdrive planetary thrust bearing.

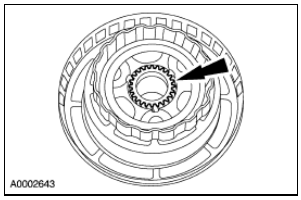


2. Install the overdrive planetary gear carrier into the center shaft and overdrive.



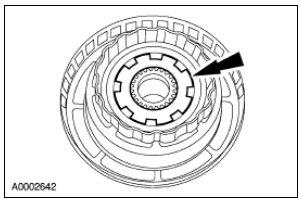
3. ⚠ **CAUTION: Make sure that the No. 12 bearing is in place in the overdrive planetary prior to installing the overdrive sun gear.**

   Install the front sun gear with the recessed gear teeth facing toward the adapter.



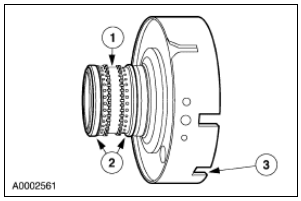
4. **NOTE:** Inspect the sun gear for damaged or worn teeth.

   Install the coast clutch-to-overdrive carrier adapter.



Center Support

Disassembly and Assembly

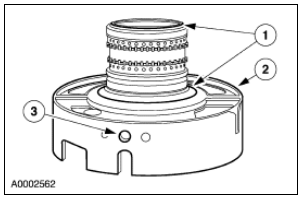


Item	Part Number	Description
1		Bearing
2		Seal rings
3	7A130	Center support

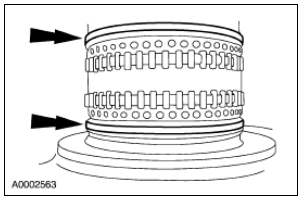
NOTE: Thoroughly clean center support assembly and blow dry with compressed air.

NOTE: The center support is repaired as an assembly. Any damage requires installing a new component.

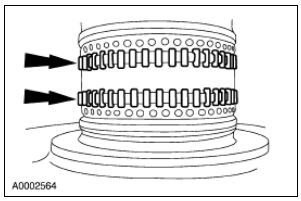
1. Inspect the center support assembly for wear or damage.
    1. Inspect the thrust surfaces for wear, scoring or damage.
    2. Inspect the center support sealing surface.
    3. Inspect the fluid passage for blockage or damage.



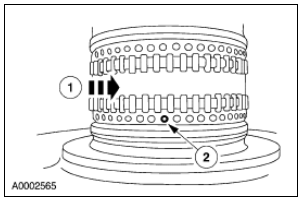
2. Inspect the seal rings for damage.



3. Inspect the bearing for missing rollers or damage.



4. Inspect the direct clutch feed hole for blockage or damage.
    1. Rotate center support bearing to locate the direct clutch feed hole.
    2. Inspect the direct clutch feed hole for blockage or damage.


1
2
A0002565

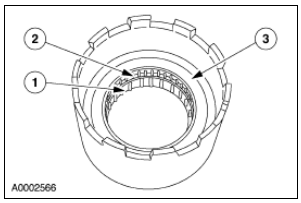
Reverse Brake Drum

Check

1. **NOTE:** The reverse one-way clutch is part of the reverse brake drum assembly. Install a new reverse brake drum as an assembly only.

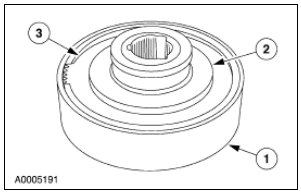
   Inspect the reverse brake drum assembly and install a new reverse brake drum assembly if damaged.

   1. Inspect the reverse brake drum sprags.
   2. Inspect the reverse brake drum rollers.
   3. Inspect the reverse brake drum.



Output Shaft Ring Gear and Hub Shaft Assembly

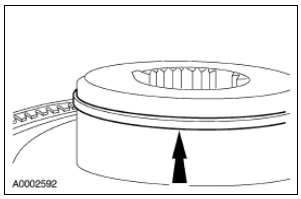
Disassembly



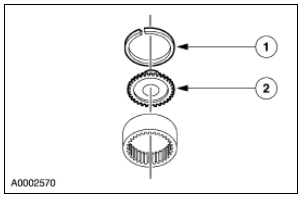
Item	Part Number	Description
1	7A153	Output shaft ring gear
2	7D164	Output shaft hub
3	7C122	Retaining ring

1. Inspect the output shaft ring gear and hub shaft assembly for damage. If repair is necessary use the following procedure.

2. Remove the seal.

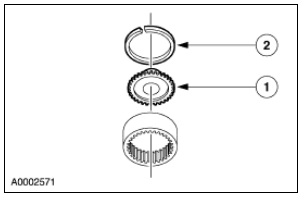


3. Remove the output shaft ring gear from the output shaft hub.
    1. Remove the retaining ring.
    2. Remove the output shaft ring gear.

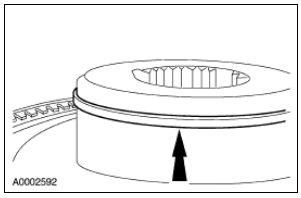


Assembly

1. Install the output shaft ring gear onto the output shaft hub.
    1. Install the output shaft ring gear.
    2. Install the retaining ring.



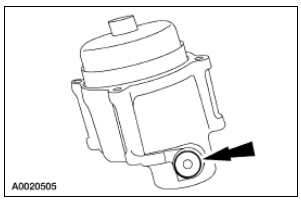
2. Install the seal.


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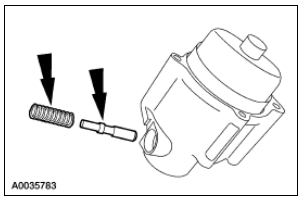
Reverse Servo Assembly

Disassembly

1. Remove the control valve spring retainer.



2. Remove the reverse servo spring and check valve.

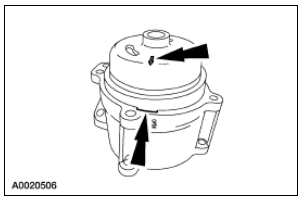


3. ⚠ **WARNING: The upper and lower servo covers are under spring tension. Use care when separating the two halves. Failure to follow these instructions may result in personal injury.**

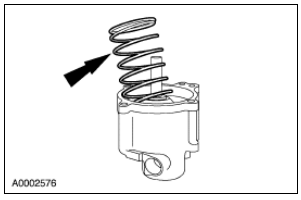
   NOTE: Tabs on servo plate mate with slots on cover every 120 degrees.

   Remove the reverse servo plate by turning in either direction to release.

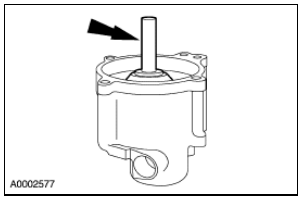
   - Align arrow on servo plate with any slot on cover.



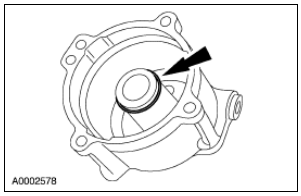
4. Remove the reverse servo spring.



5. Remove the reverse servo piston and seal assembly.
   - Inspect the seal for damage, install new reverse servo piston if necessary.



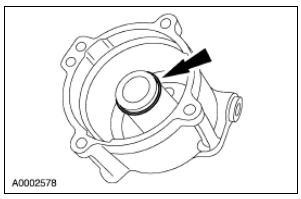
6. Remove and discard the reverse servo piston seal.



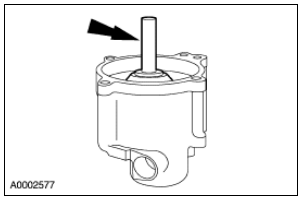
Assembly

1. **NOTE:** Try not to roll the seal onto the housing when installing the seal or damage to the seal could occur.

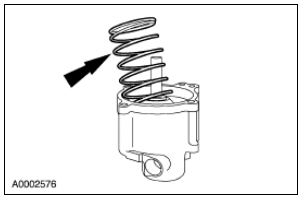
   Lubricate and install a new reverse servo piston seal.



2. Lubricate and install reverse servo piston and seal assembly.

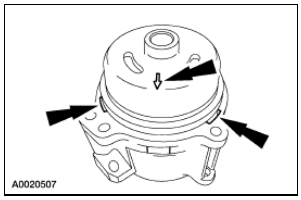


3. Install the reverse servo spring.

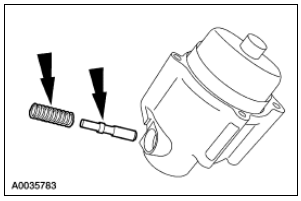


4. ⚠ **CAUTION: The arrow on the servo plate must be aligned evenly between any two slots on the cover.**

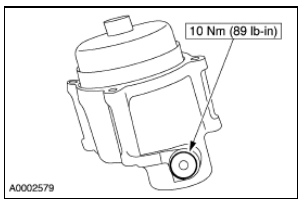
   Install the reverse servo plate.



5. Install the reverse servo spring and check valve.



6. Install the control valve spring retainer.



Torque Converter

1. A new torque converter must be installed if one or more of the following statements are true:
   - A torque converter failure has been determined based on complete diagnostic procedures.
   - Converter stud(s), impeller hub or bushing are damaged.
   - Discoloration of the torque converter (due to overheating).
   - The torque converter is found to be out of specification when carrying out one of the following torque converter checks:
     - One-Way Clutch Check
     - End Play Check
     - Stator to Turbine Interference Check
     - Stator to Impeller Interference Check
     - Torque Converter Leak Check
   - Evidence of transmission assembly or fluid contamination due to the following transmission or converter failure modes:
     - major metallic failure
     - multiple clutches or clutch plate failures
     - sufficient component wear which results in metallic contamination

Torque Converter Cleaning And Inspection

1. If a new torque converter is being installed, continue with Substep 2 of Step 2.

2. **⚠ CAUTION: The torque converter drain plug and seal are not reusable. Discard the drain plug and seal, install a new drain plug assembly.**

   If a new torque converter is not being installed, the following procedures must be carried out:

   1. The torque converter must be thoroughly cleaned.
      - Torque converter with drain plugs can be cleaned by using a suitable torque converter/fluid cooler cleaner.
      - **⚠ CAUTION: Do not use water based cleaners or transmission damage will occur.**

        A torque converter without drain plugs can be cleaned by hand. Partially fill the torque converter using only recommended transmission fluid for the applicable transmission. Hand-agitate the torque converter and then thoroughly drain the fluid. Fill the torque converter with new fluid specified for the transmission, and install.
   2. All in-tank and auxiliary coolers must be thoroughly cleaned by forward and backward flushing. For additional information, refer to Transmission Fluid Cooler Backflushing and Cleaning in this section.
   3. All cooler tubes must be thoroughly cleaned by backward and forward flushing. For additional information, refer to Transmission Fluid Cooler Backflushing and Cleaning in this section.
   4. All cooler bypass valves (CBV), if equipped, must be thoroughly cleaned.
   5. Carry out the Transmission Fluid Cooler Flow Test. For additional information, refer to Section 307-02 .
   6. If the transmission cooling system fails the Transmission Fluid Cooler Flow Test, install new components as necessary. For additional information, refer to Section 307-02 .
   7. If new coolers are to be installed, use only factory-approved repair parts. For additional information, refer to Section 303-03 .

Torque Converter Flushing

Material

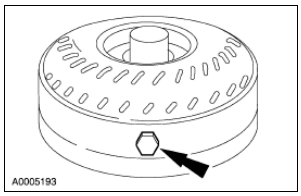
Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM, XT-5-DM	MERCON® V

1. **⚠ CAUTION: The torque converter drain plug and seal are not reusable. Discard the drain plug and seal, install a new drain plug and seal assembly.**

   ⚠ CAUTION: Mineral spirits used to clean the torque converter must be fresh, non-water based, non-chlorinated and non-halogenated.

   Using a suitable torque converter/fluid cooler cleaner, flush the torque converter.

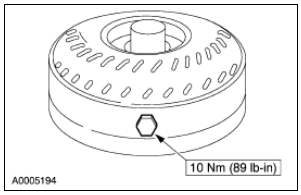
2. After flushing, remove the drain plug and drain the remainder of the solvent.



3. Add 1.9 liter (2 qt.) of clean automatic transmission fluid into the converter fluid filler tube and agitate by hand.

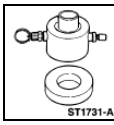
4. Thoroughly drain the solution.

5. Install a new torque converter drain plug.



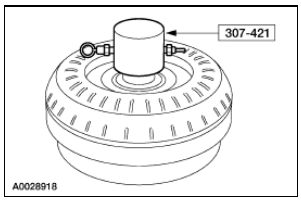
Torque Converter Leak Check

Special Tool(s)

 ST1731-A	Leak Tester, Torque Converter 307-421

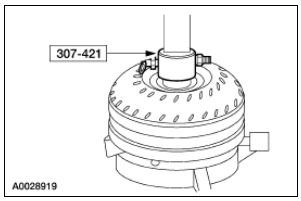
1. Clean the outside surface of the torque converter.

2. Install the special tools into converter hub.



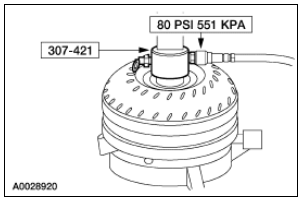
3. ⚠ **WARNING: Always follow correct safety procedures while using the press. Failure to follow these instructions may result in personal injury.**

   Install the torque converter with the special tool installed into the arbor press.
   Secure the press. Apply enough force from the press to seal the tool into the torque converter.

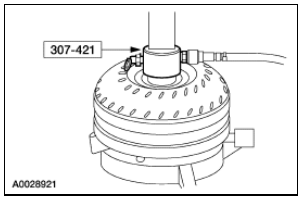


4. **NOTE:** Use clean, dry shop air.

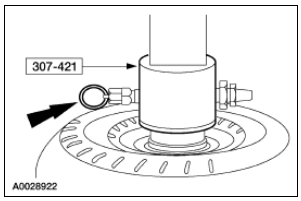
   Apply air pressure to valve on the special tool.



5. With air pressure applied to the valve, inspect for leaks at the converter hub, the seams, drain plug, and the studs. A soap bubble solution can be applied around those areas to aid in the diagnosis. If a leak is found around the drain plug install a new drain plug and recheck the torque converter. If any other leaks are present, install a new or remanufactured converter.

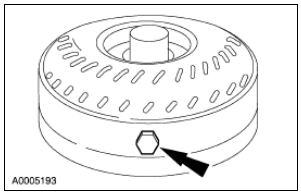


6. Remove the air hose. Release the pressure, and then slowly release the press. Remove the converter. Remove the tool.

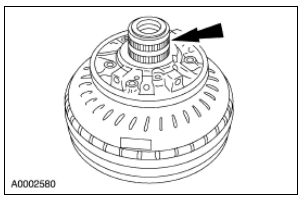


Torque Converter Impeller to Pump Stator Interference Check

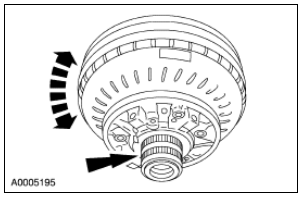
1. Remove the drain plug and drain the fluid from the torque converter.



2. Install fluid pump support into torque converter. Engage splines of the one-way clutch inner race with the mating splines of the overdrive pump support.

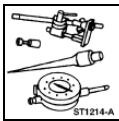
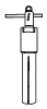


3. While holding the fluid pump support stationary, rotate the torque converter clockwise and counterclockwise. The torque converter should rotate freely with no signs of scraping. If there are signs of scraping, install a new or remanufactured torque converter.

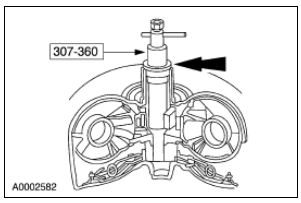


Torque Converter End Play Check

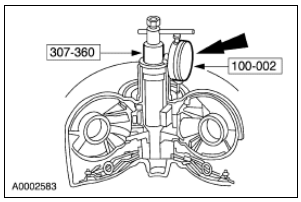
Special Tool(s)

 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST2128-A	End Play Gauge, Torque Converter 307-360

1. Install the special tool into the torque converter until it bottoms out.
   - Tighten the inner post until the tool is securely locked.



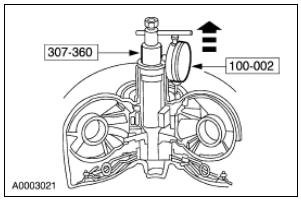
2. Install the special tool on the converter impeller housing and zero the dial.



3. Lift up on the special tool and note the dial indicator reading. If the reading exceeds end play limits, install new or rebuilt torque converter.

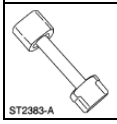
   Torque Converter End Play

New or Rebuilt Torque Converter	Used Torque Converter
0.44 mm (0.017 in)	Max. 0.80 mm (0.031 in)

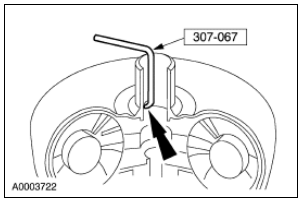


Torque Converter One-Way Clutch Check

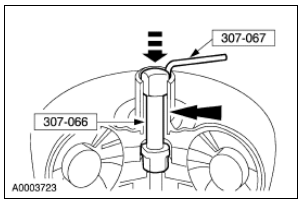
Special Tool(s)

 ST1195-A	Holding Tool, Torque Converter Clutch 307-067 (T77L-7902-R)
 ST2383-A	Torque Adapter, Torque Converter Clutch 307-066 (T77L-7902-B)

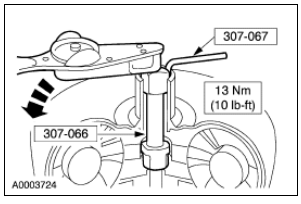
1. Insert the special tool in one of the grooves in the stator bearing retainer.



2. Install the special tools in the converter one-way clutch inner race spline.



3. Use the special tool to hold the stator bearing retainer while using the special tool to turn the converter one-way clutch inner race spline.
   - The torque converter one-way clutch should lock up and hold torque in the counter clockwise direction.
   - The torque converter one-way clutch should rotate freely in the clockwise direction.
   - Try the clutch for lockup and hold in at least five positions.
   - If the converter fails the lockup test torque, install a new or rebuilt torque converter.

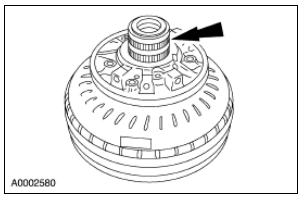


Torque Converter Turbine to Pump Stator Interference Check

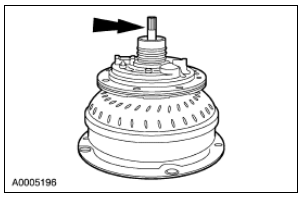
1. **NOTE:** The pump support may remain in the pump assembly during this test.

   Position the torque converter with the pump drive up.

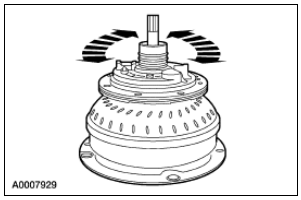
2. Install the pump support into the torque converter. Engage the splines of the one-way clutch inner race with the mating splines of the front pump support.



3. Install the input shaft engaging the splines with the turbine hub.



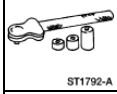
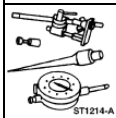
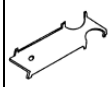
4. Check for stator to turbine interference.
   1. Hold the front pump support stationary.
   2. Attempt to rotate the input shaft.
      - ♦ The turbine and damper assemblies should rotate in both directions not exceeding maximum torque of 7 Nm (62 lb-in) without any signs of metallic interference or scraping noise.

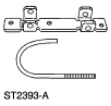
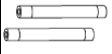
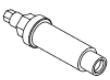
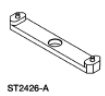


5. If interference exists, the stator front thrust washer may be worn, allowing the stator to hit the turbine. In such cases, a new or remanufactured torque converter must be installed.
   - The converter crankshaft pilot should be checked for nicks or damaged surfaces that could cause interference when installing the torque converter into the crankshaft. Check the converter front impeller hub for nicks or sharp edges that would damage the pump seal.

Transmission

Special Tool(s)

 ST1792-A	Adjustment Set, Transmission Band 307-S022 (T71P-77370-A)
 ST1200-A	Remover, Bearing Cup 308-047 (T77F-1102-A)
 ST1635-A	Installer, Output Shaft Bearing 307-348 (T97T-77110-A)
 ST1186-A	Holding Fixture, Transmission 307-003 (T57L-500-B)
 ST1274-A	Depth Micrometer 303-D026 (D80P-4201-A)
 ST1214-A	Dial Indicator Gauge with Holding Fixture 100-002 (TOOL-4201-C) or equivalent
 ST1633-A	Alignment Gauge, TR Sensor 307-351 (T97L-70010-A)
ST1255-A	Adapter for 303-224 (Handle) 205-153 (T80T-4000-W)
 ST1791-A	Installer, Transmission Extension Housing Fluid Seal 307-038 (T74P-77052-A)
 ST1826-A	Sizer, Piston Seal 307-338 (T95L-70010-G)
 ST1817-A	Alignment Set, Fluid Pump 307-S039 (T74P-77103-X)
 ST2532-A	Alignment Gauge Transmission Fluid Pump 307-431
 ST2533-A	Alignment Gauge Transmission Fluid Pump 307-432

 ST2432-A	Gauge Bar 307-400
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)
 ST2393-A	Compressor, Servo Cover 307-402
 ST1199-A	Installer, Shift Shaft Fluid Seal 307-050 (T74P-77498-A)
 ST1631-A	Handles, Torque Converter 307-091 (T81P-7902-C)
 ST1639-A	Aligner, Valve Body 307-334 (T95L-70010-C) (2 req'd)
 ST2440-A	Installer, Drive Pinion Flange 205-479
 ST2416-A	Installer, Output Shaft Flange 307-404
 ST2433-A	Alignment Pins, Transmission Fluid Pump 307-399
 ST2424-A	Compressor, Cushion Spring 307-401
 ST1104-B	Retaining Ring Pliers 307-343 (T95P-77001-AHR)
 ST2426-A	Aligner, Flex Plate 307-403

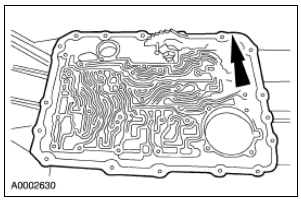
Material

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM	MERCON® V
Multi-Purpose Grease D0AZ-19584-AA	ESB-M1C93-B

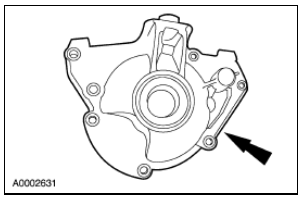
1. Thoroughly clean the transmission case and extension housing in solvent and blow dry with compressed air.

2. Inspect the transmission case for the following:

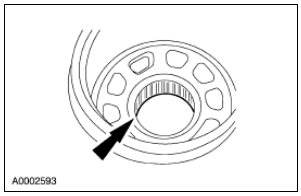
- stripped bolt hole threads
- gasket and mating surfaces for burrs or nicks
- obstructed vent and fluid passages
- cracks or warpage



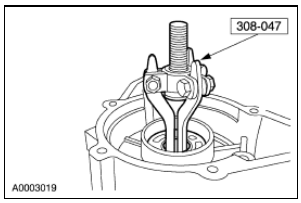
3. Inspect the extension housing for cracks, burrs or warpage.



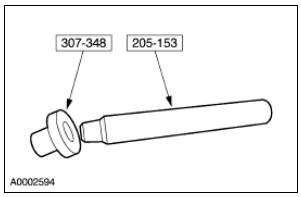
4. Inspect case bearing for damage. Install a new component as necessary. Follow Steps 5-8 if replacing the case bearing. If not replacing the case bearing, proceed to Step 9.



5. Using the special tool, remove the case bearing.
   - Use an oil stone to remove any nicks or burrs in the bearing case bore.

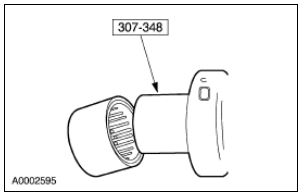


6. Assemble the special tools.

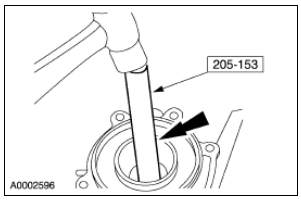


7. ⚠ **CAUTION: Make sure bearing seal ring is facing the drive handle.**

   Install the bearing on the special tools.

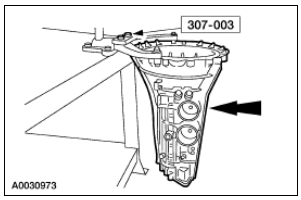


8. Using the special tool, tap case bearing into case bearing bore.

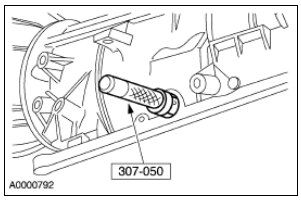


9. ⚠ **WARNING: Make sure the lock pin on bench-mounted holding fixture is secure. Failure to follow these instructions can result in personal injury.**

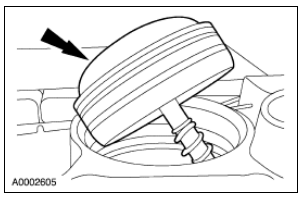
   Using the special tool, install the transmission into the bench with the converter housing facing up.



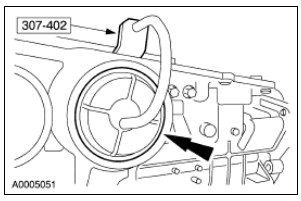
10. Using the special tool, install the manual control lever shaft seal and lubricate it with petroleum jelly.



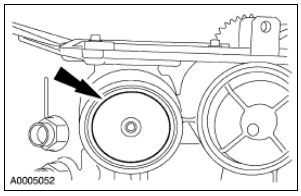
11. Install the intermediate servo piston and spring.
    - Lubricate the servo bore with clean automatic transmission fluid.



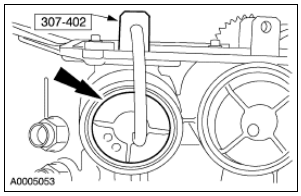
12. Using the special tool, install the retaining ring.



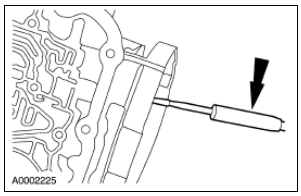
13. Install the overdrive band servo piston and spring.
    - Lubricate the servo bore with clean automatic transmission fluid.



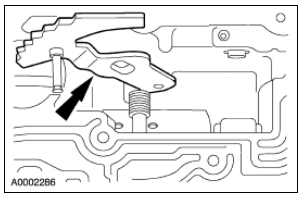
14. Using the special tools, install the retaining ring.



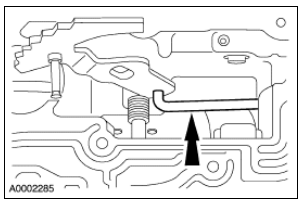
15. Install the parking lever rod.



16. Install the manual control lever.

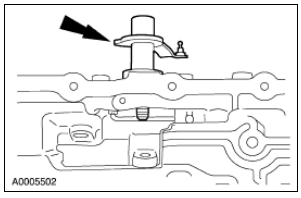


17. Assemble the manual valve inner lever and parking lever actuating rod as shown.

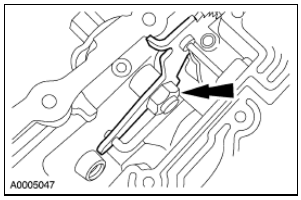


18. ⚠ **CAUTION: Align the flats on the manual valve inner lever with the flats on the manual control lever shaft.**

    Install the manual control lever shaft.



19. Install the manual valve inner lever onto the manual shaft and loosely install the nut.

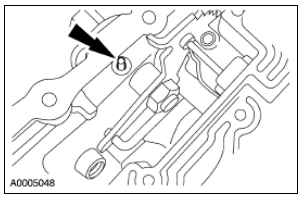


20. ⚠ **CAUTION: Use care not to damage the fluid pan rail surface when installing the retaining pin.**

    NOTE: Align the manual control lever shaft alignment groove with the manual control lever shaft spring pin bore in the transmission case.

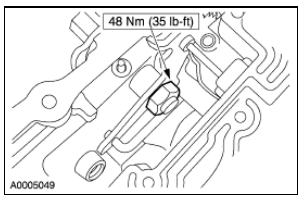
    Install the manual control lever shaft spring pin.

    - Tap the manual control lever shaft spring pin into the transmission case.



21. ⚠ **CAUTION: To avoid damage, do not allow the wrench to strike the manual valve inner lever pin.**

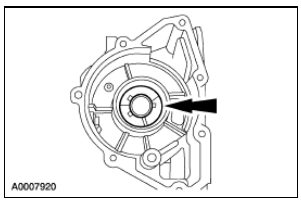
    Tighten the nut.



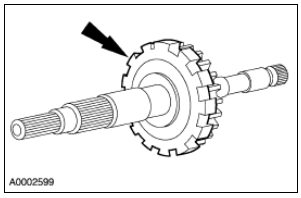
22. ⚠ **CAUTION: The tabs on the output shaft thrust washer (No. 11) point into the case. Make sure the thrust washer is correctly seated.**

    Install the output shaft thrust washer (No. 11).

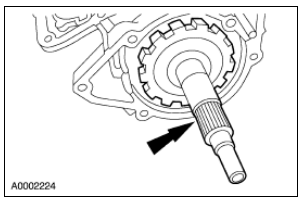
    - Coat the output shaft thrust washer with petroleum jelly.



23. Install the park gear on the output shaft.

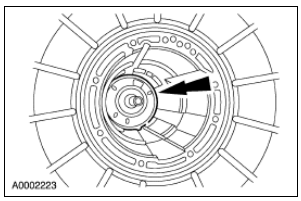


24. Install the output shaft and park gear.

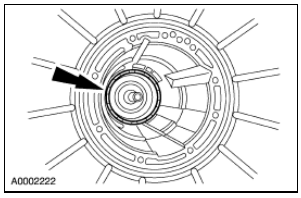


25. ⚠ **CAUTION: Make sure band is resting on the two anchor pins in the case.**

    Install the low/reverse band.

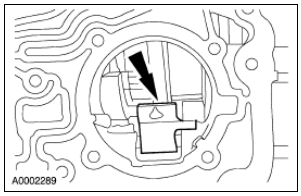


26. Install the low/reverse brake drum.
    - Rotate the low/reverse brake drum clockwise to install.

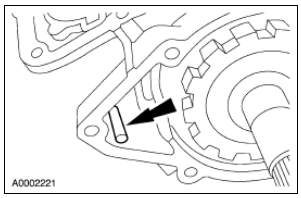


27. **NOTE:** The reverse band actuating lever must fit into the notches in the band.

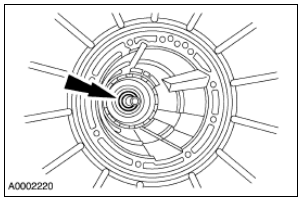
    Install the reverse band actuating lever into the reverse band.



28. Install the reverse band actuating lever shaft into the case and into the reverse band actuating lever.

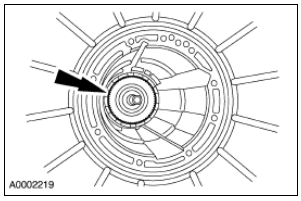


29. Install the No.10 needle bearing into the case.



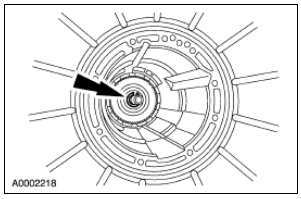
30. ⚠ **CAUTION: Do not damage the seal against the case during assembly.**

    Install the output shaft ring gear, hub and seal.



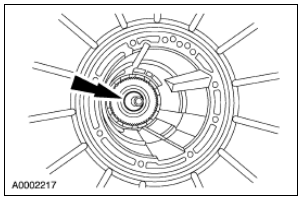
31. ⚠ **CAUTION: Always install a new output shaft retaining ring.**

    Install a new output shaft retaining ring.

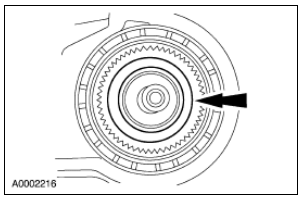


32. **NOTE:** Install the output shaft sleeve with the cone facing up. This sleeve will snap into place when correctly installed.

    Install the output shaft sleeve.

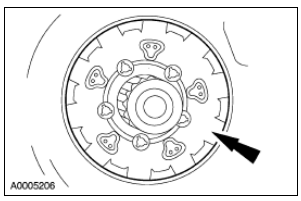


33. Install low/reverse planetary carrier needle bearing (No. 9) onto the output shaft ring gear and hub assembly.



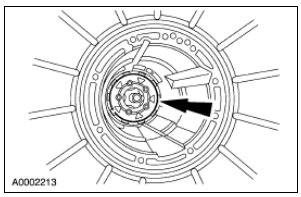
34. ⚠ **CAUTION: Make sure the needle bearings stay in place.**

    Install the low/reverse planetary assembly.

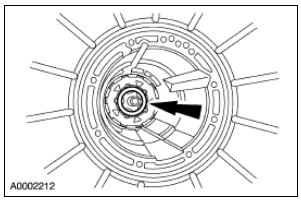


35. ⚠ **CAUTION: The low/reverse brake drum must be pulled forward to install the low/reverse planet retaining ring.**

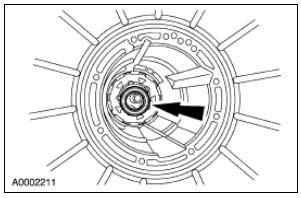
Install the retaining ring.



36. Install the No. 8 thrust bearing.

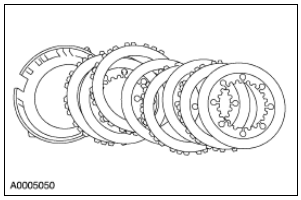


37. Install the low and reverse gear spacer.



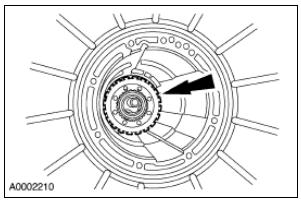
38. ⚠ **CAUTION: If new clutch plates are being used, they should be soaked in clean automatic transmission fluid 30 minutes prior to installation. The friction side of the plates must face down toward cylinder.**

    Install the new clutch plates in an alternating order, starting with an internally splined clutch plate into the clutch cylinder.

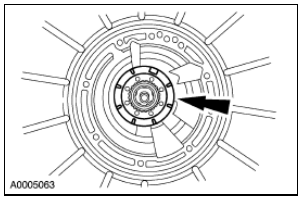


39. Install the clutch plate retaining ring.

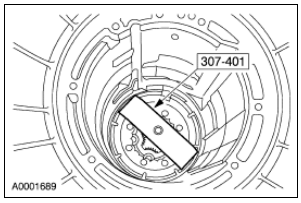
40. Install the intermediate clutch assembly.



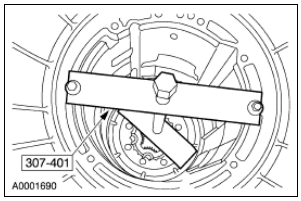
41. Install the intermediate clutch housing and piston assembly.



42. Install the special tools.

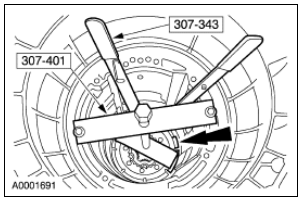


43. Install the special tools.



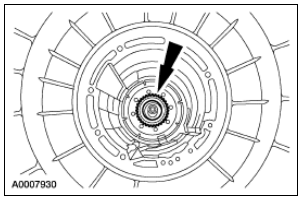
44. ⚠ **CAUTION: Do not use the original intermediate clutch retaining ring that was removed during disassembly.**

    Using the special tools, install a new service intermediate clutch retaining ring.

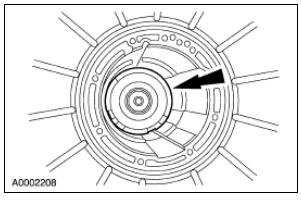


45. **NOTE:** The recess portion of the sprag must face down during installation.

    Install the sprag and race assembly.

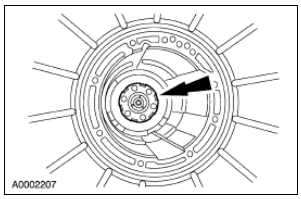


46. Install the input shell and sun gear assembly.

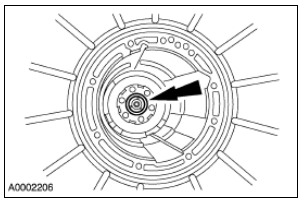


47. **NOTE:** The No. 13 bearing must be properly seated in the forward planet assembly so the sungear can be installed correctly.

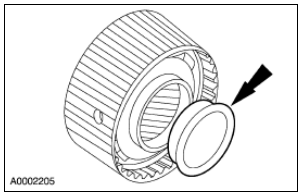
    Install the forward planetary assembly.



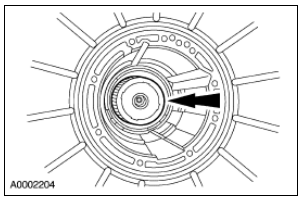
48. Install the No. 7 forward planet thrust bearing into the forward ring gear and hub assembly. Use petroleum jelly to hold the bearing in place.



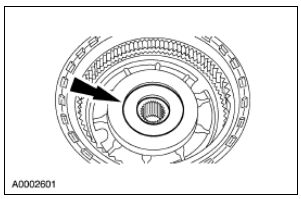
49. Install the No. 6B forward clutch thrust washer onto the forward ring gear hub.



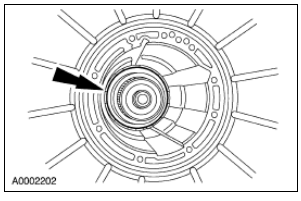
50. Install the forward ring gear and hub as an assembly.



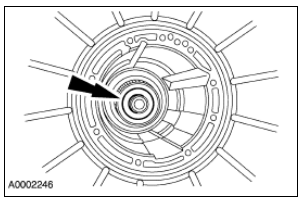
51. Install the No. 6A forward ring gear hub thrust bearing into the forward clutch. Use petroleum jelly to hold the bearing in place.



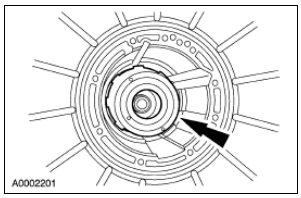
52. Install the forward clutch cylinder.



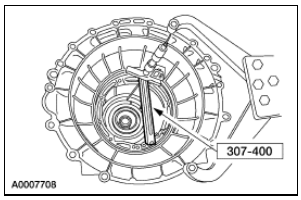
53. Install the No. 5 thrust bearing.



54. Install the direct clutch drum.



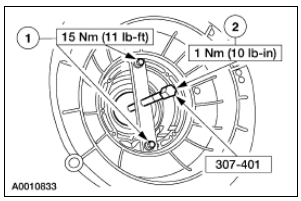
55. Using a depth micrometer with an 8-inch extension, measure from the top of the gauge bar to center support ledge in case at four places 90 degrees apart.
    - Add the four measurements, divide by four, and record as dimension A.



56. ⚠ **CAUTION: The torque specifications are critical for this procedure. Failure to use the correct torque specifications may cause transmission damage.**

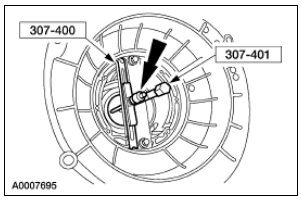
    Install the special tool.

    1. Install the special tool and the bolts using the two pump screw locations at approximately 6 and 12 o'clock positions.
    2. Tighten the center screw.



57. **NOTE:** Align the disc holes on special tool with the slot in gauge bar for correct measurement.

    Measure the distance from the top of the gauge bar to the drum bearing surface through the hole in the disc and record as dimension B. Repeat measurement 180 degrees opposite side of the special tool and record as dimension C.



58. Add dimension B to C, divide by two and record as dimension D.

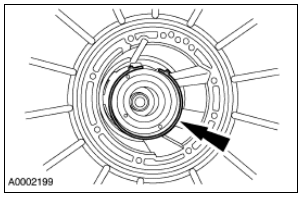
59. Subtract A from D, and record as dimension E.

60. Select bearing from the following chart, using dimension E.

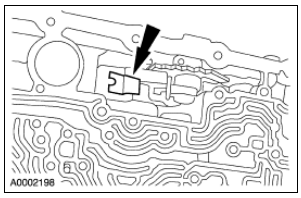
Dimension E	Service Part Number (7D014)	Bearing Thickness	Identification (Notches)
1.69-1.87 mm (0.066-0.073 in)	XW4Z-CA	2.65-2.80 mm (0.104-0.110 in)	None
1.88-2.05mm (0.073-0.080 in)	XW4X-DA	2.83-2.98mm (0.111-0.116 in)	One
2.05-2.22 mm (0.081- 0.088 in)	XW4Z-EA	3.01-3.16mm (0.118-0.124 in)	Two
2.33-2.43 mm (0.089-0.096 in)	XW4Z-FA	3.21-3.36 mm (0.126-0.132 in)	Three

61. **NOTE:** Make sure that the intermediate apply strut is aligned with the band notch.

    Install the intermediate band.

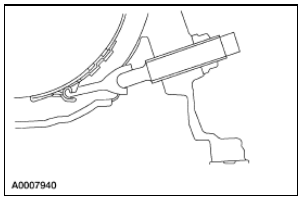


62. Install the intermediate band anchor strut.

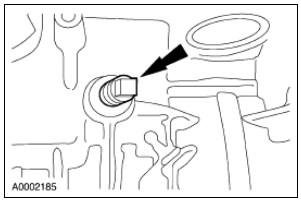


63. ⚠ **CAUTION: If the strut is installed incorrectly, transmission damage will occur.**

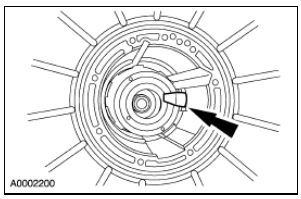
    Check to make sure that the intermediate band anchor strut is installed in the correct orientation to the case and adjustment screw.



64. Loosely install the screw.

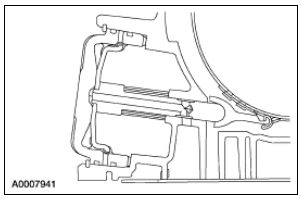


65. Install the intermediate band apply strut.

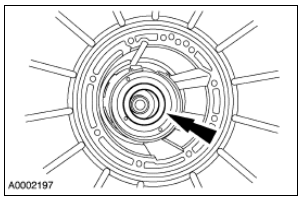


66. ⚠ **CAUTION: If the strut is installed incorrectly, transmission damage will occur.**

    Check to make sure that the intermediate band apply strut is installed in the correct orientation to the case and piston rod.

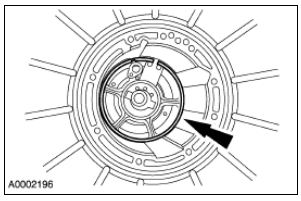


67. Install the selected No. 4 thrust washer on the direct clutch drum.
    - Coat the thrust washer with petroleum jelly.

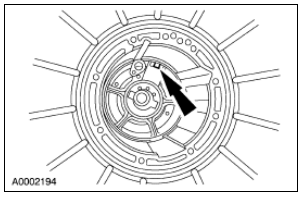


68. **NOTE:** Align the center support screw hole with correct case hole.

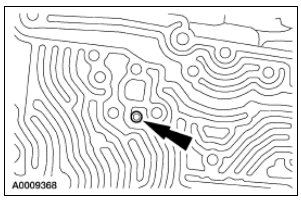
    Install the center support.



69. Install the center support locknut and cage.



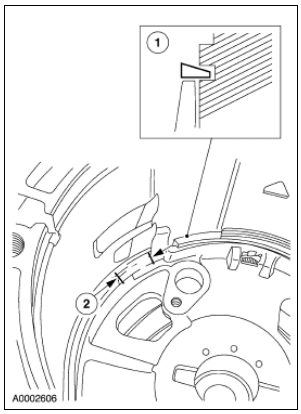
70. Loosely install the screw.



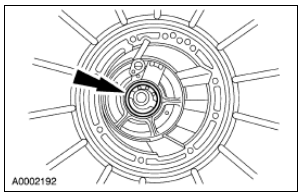
71. **⚠ CAUTION: Install the center support retaining ring with the tapered side facing up.**

    ⚠ CAUTION: Make sure the center support retaining ring does not obstruct the notch opening.

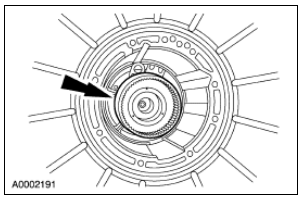
    Install the center support retaining ring.



72. Install the center shaft thrust bearing (No. 3).

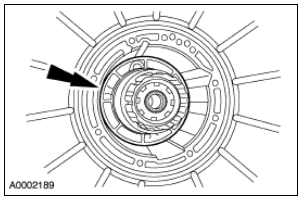


73. Install the overdrive ring gear, overdrive one-way clutch and center shaft assembly.

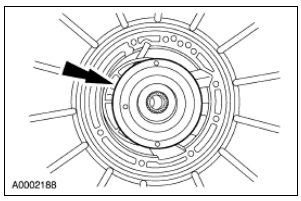


74. **⚠ CAUTION: Do not bend the trigger wheel. Make sure that the No. 2 thrust bearing is in this assembly.**

    Install the planetary gear overdrive carrier.

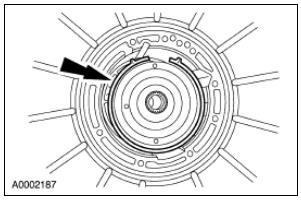


75. Install the overdrive brake drum and coast clutch drum assembly.

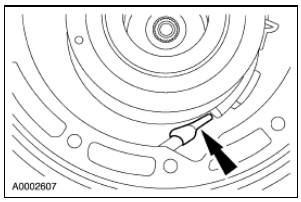


76. **NOTE:** If the overdrive band is reused, it must be installed in the same position from which it was removed.

    Install the overdrive band.

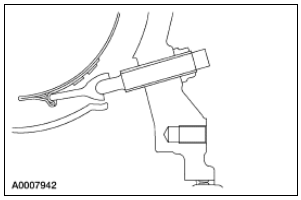


77. Install the overdrive anchor strut.

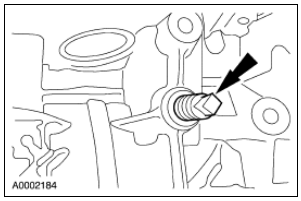


78. ⚠ **CAUTION: If the strut is installed incorrectly, transmission damage will occur.**

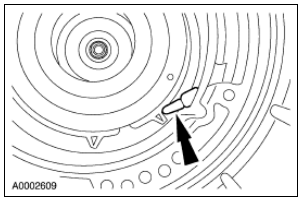
    Check to make sure that the overdrive band anchor strut is installed in the correct orientation to the case and adjustment screw.



79. Loosely install the screw.

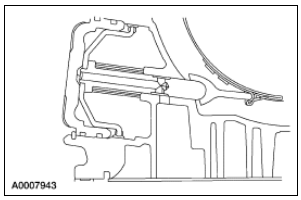


80. Install the overdrive apply strut.



81. ⚠ **CAUTION: If the strut is installed incorrectly, transmission damage will occur.**

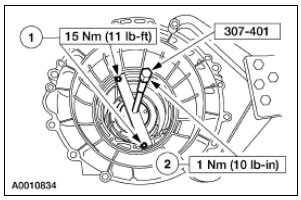
    Check to make sure that the overdrive band apply strut is installed in the correct orientation to the case and piston rod.



82. ⚠ **CAUTION: The torque specifications are critical for this procedure. Failure to use the correct torque specifications can cause transmission damage.**

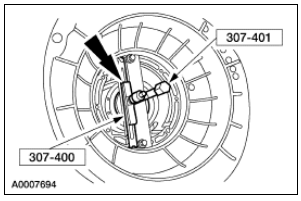
    Install the special tool.

    1. Install the special tool and the bolts, using the two pump screw locations at approximately 6 and 12 o'clock positions.
    2. Tighten the center screw.



83. **NOTE:** Align the disc holes on special tool with the slot in gauge bar for correct measurement.

    Measure the distance from the top of the gauge bar to the drum bearing surface through the hole in the disc and record as dimension A. Repeat measurement 180 degrees opposite side of the special tool and record as dimension B.



84. Add dimension A to B, divide by two and record as dimension C.

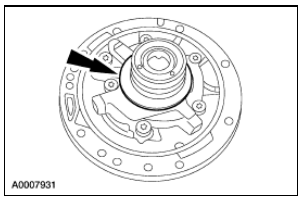
85. Subtract the thickness of the gauge bar (17.78 mm or 0.700 in) from dimension C, and record as dimension D.

86. Select the No.1 thrust bearing from the following chart, using dimension D.

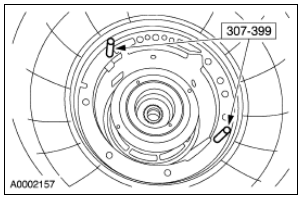
Dimension D	Service Part Number (7D014)	Bearing Thickness	Identification (Color/ID)

38.04-38.28 mm (1.50-1.51 in)	XW4Z-XA	1.70-1.75 mm (0.06 in)	Brown/8
38.29-38.43 mm (1.51 in)	XW4Z-NA	1.85-1.90 mm (0.07 in)	Red/4
38.44-38.63 mm (1.51-1.52 in)	XW4Z-RA	2.05-2.10 mm (0.08 in)	Black/6
38.64-38.78 mm (1.52-1.53 in)	XW4Z-YA	2.20-2.25 mm (0.09 in)	Orange/9
38.79-38.97 mm (1.53 in)	XW4Z-ZA	2.40-2.45 mm (0.10 in)	Purple/10

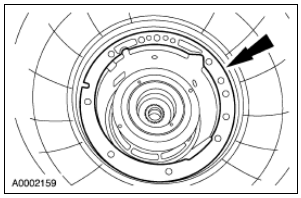
87. Install the selected No. 1 fluid pump input thrust washer.
    - Coat the fluid pump input thrust washer with petroleum jelly.



88. Install the special tools into the transmission case.

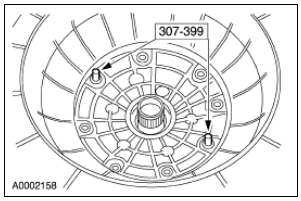


89. Install the pump gasket.



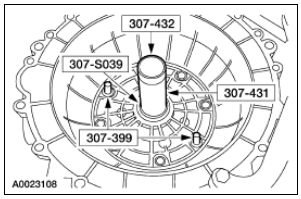
90. ⚠ **CAUTION: Make sure that the fluid pump inlet thrust washer (No. 1), selective thrust washer, fluid pump gasket, and the fluid pump-to-case O-ring seal remain in the correct position throughout this step.**

    Install the fluid pump.

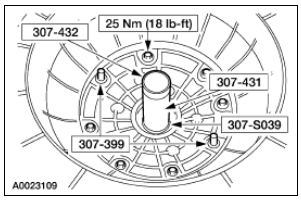


91. ⚠ **CAUTION: The special tools must be used to correctly align the pump with the adapter plate to reduce gear noise, bushing failure and leakage.**

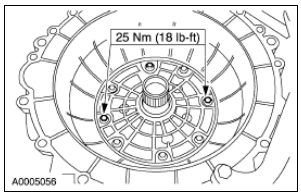
Using the special tool, align the fluid pump to the adapter plate.



92. Install screws. Tighten the screws in a star pattern.



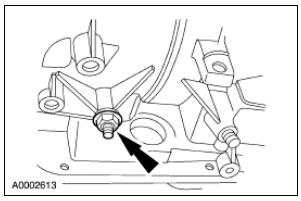
93. Remove the special tools and install the two remaining screws.



94. ⚠ **CAUTION: Do not allow overdrive band adjustment screw to back out. Band strut could fall out of position.**

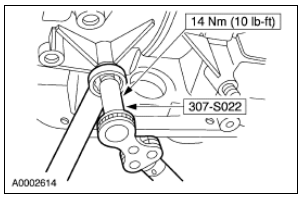
    ⚠ **CAUTION: Install, but do not tighten, a new locknut on the band adjustment screw. Apply petroleum jelly to the locknut seal.**

    Install a new locknut on the band adjustment screw.

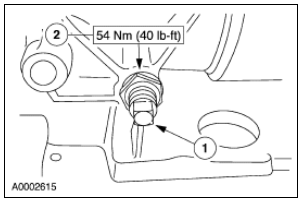


95. ⚠ **CAUTION: The overdrive servo must be installed prior to band adjustment.**

    Using the special tool, tighten the overdrive band adjustment screw then back off the screw exactly (2) turns and hold that position.



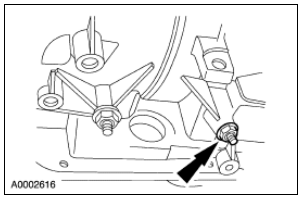
96. Tighten the overdrive band locknut.
    1. Hold the overdrive band adjustment screw stationary.
    2. Tighten the overdrive band locknut.



97. ⚠ **CAUTION: Do not allow the intermediate band adjusting screw to back out. Band strut could fall out of position.**

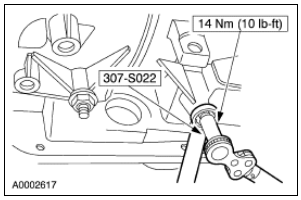
    ⚠ **CAUTION: Install, but do not tighten, a new locknut on the band adjustment screw. Apply petroleum jelly to the locknut seal.**

    Install new nut on the band adjustment screw.

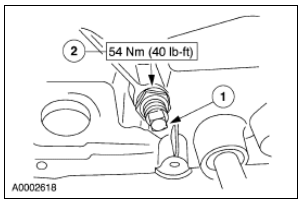


98. ⚠ **CAUTION: The intermediate servo must be installed prior to band adjustment.**

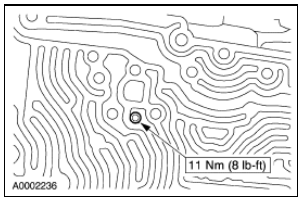
    Tighten the intermediate band adjustment screw then back off the screw exactly (2) turns and hold that position.



99. Tighten the intermediate band locknut.
    1. Hold the intermediate band adjustment screw stationary.
    2. Tighten the intermediate band locknut.

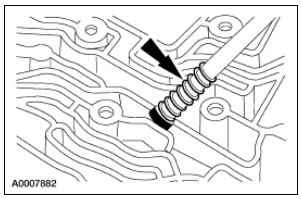


100. Tighten the center support screw.

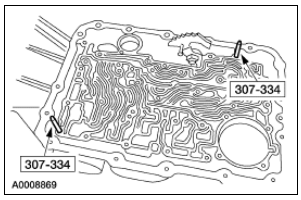


101. ⚠ **CAUTION: The intermediate clutch fluid inlet tube seal and spring must be correctly seated in the case. Failure to correctly seat the inlet tube seal and spring will cause an internal fluid leak and transmission damage.**

Using a drift punch, correctly install and seat the intermediate clutch fluid inlet tube seal and spring into the case.

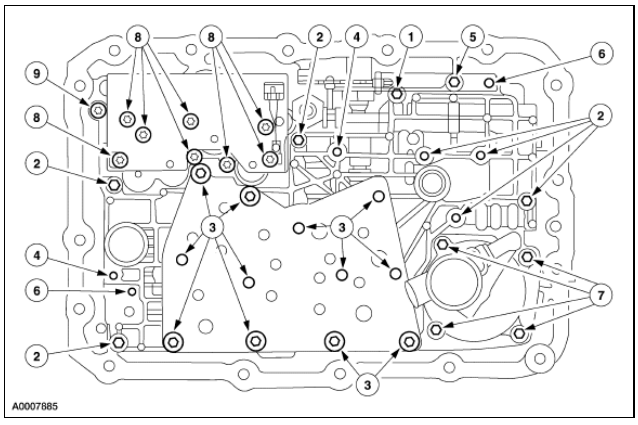


102. Install the special tools into the transmission case.

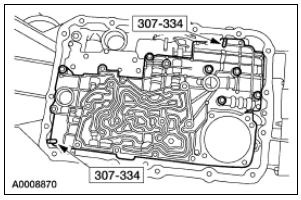


103. Refer to the following chart for bolt locations.

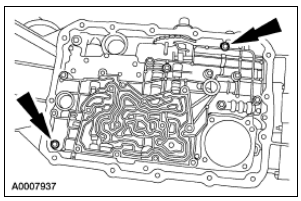
Item	Part No.	Part Name	Size
1	W702791-S300	Hex Bolt	M6X27
2	W500103-S1300	Hex Bolt	M6X45
3	W703133-S1300	Hex Bolt	M6X52
4	W705559-S300	Hex Bolt	M6X82.2
5	W500100-S300	Hex Bolt	M6X30
6	W701099-S1430	Cap Int Lob Screw	M6X20
7	W703135-S1300	Hex Bolt	M6X70
8	W703189-S1430	Cap Int Lob 8	M6X63
9	W702921-S430	Cap Int Lob 8	M6X25



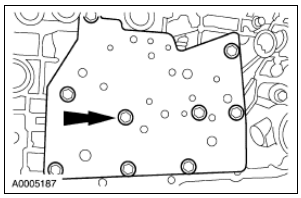
104. Install the main control valve body and loosely install the screws.



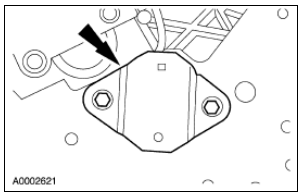
105. Remove the special tools and loosely install the screws.



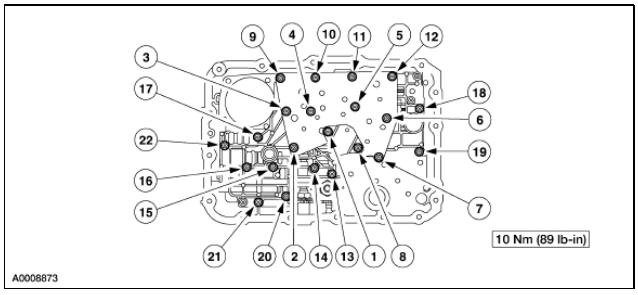
106. Install the valve body cover plate and gasket and loosely install the screws.



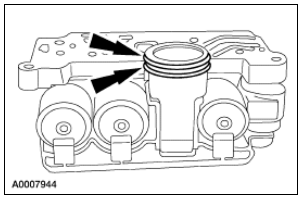
107. Install a new reverse pressure switch and loosely install the screws.



108. Tighten the screws in the sequence shown.

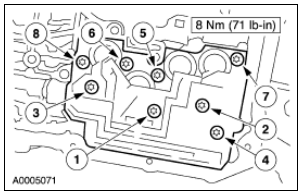


109. Install new O-ring seals on the solenoid body connector. Lubricate the O-ring seals with clean automatic transmission fluid.

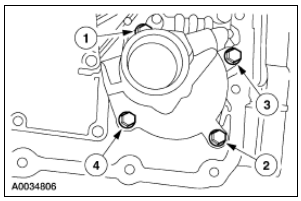


110. ⚠ **CAUTION: Inspect the transmission case bore to make sure it is free of debris and not damaged. If damaged, transmission leak can result.**

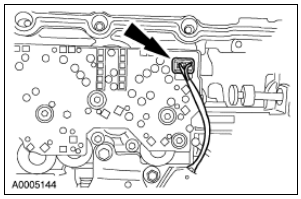
Install the solenoid body. Tighten bolts in sequence shown.



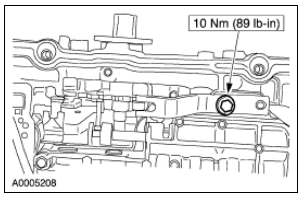
111. Install the reverse servo.Tighten the bolts in sequence shown in two stages.
    - Stage 1: Tighten bolts to 5 Nm (44 lb-in)
    - Stage 2: Tighten bolts to 11 Nm (8 lb-ft)



112. Connect the reverse pressure switch connector.



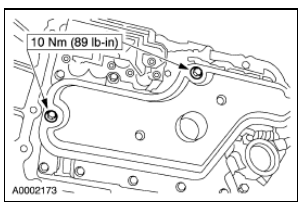
113. Install the manual valve detent spring.



114. ⚠ **CAUTION: Lubricate the fluid filter O-ring seals with clean automatic transmission fluid or they can be damaged.**

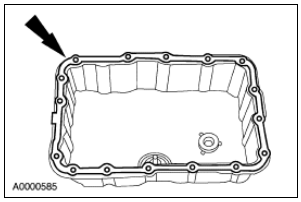
    NOTE: Make sure that the fluid filter O-ring seals are correctly seated on the filter.

    Lubricate the seals and install the transmission fluid filter.

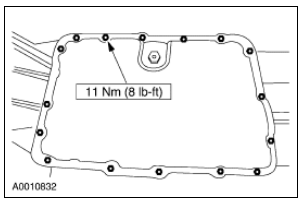


115. **NOTE:** The transmission fluid pan gasket is reusable. Clean and inspect for damage. If not damaged, the gasket should be reused.

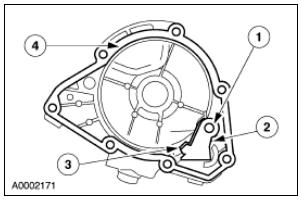
    Install the transmission fluid pan and gasket.



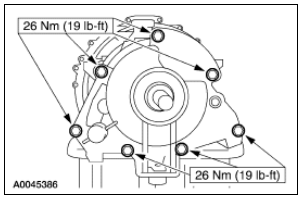
116. Tighten the screws in a crisscross sequence.



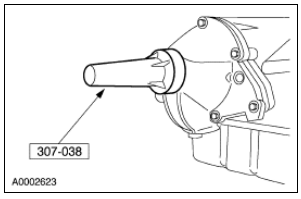
117. Install the parking pawl assembly and gasket.
    1. Install the parking pawl shaft.
    2. Install the parking pawl.
    3. Install the parking pawl return spring.
    4. Install the gasket.



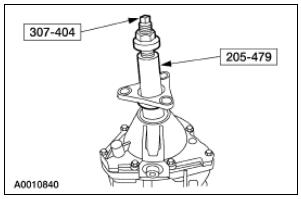
118. Install the extension housing.



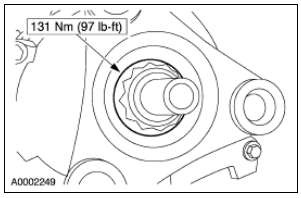
119. Using the special tool, install the extension housing seal.



120. Using the special tools, install the output shaft flange.

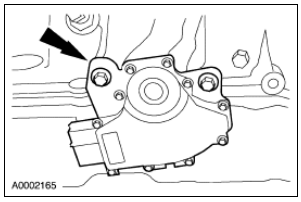


121. Install a new nut.



122. ⚠ **CAUTION: The digital transmission range sensor must fit flush against the boss on the case to prevent damage to the sensor.**

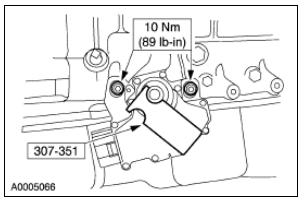
    Install the digital transmission range (TR) sensor and loosely install the screws.



123. ⚠ **CAUTION: Tightening one screw before tightening the other can cause the sensor to bind or become damaged.**

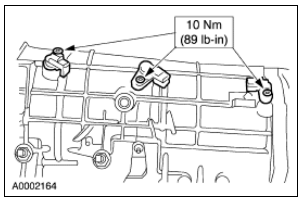
    NOTE: The manual lever must be in the NEUTRAL position.

    Using the special tool, align the digital TR sensor and tighten the screws in an alternating sequence.



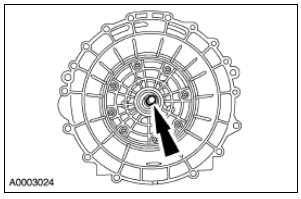
124. **NOTE:** Inspect O-ring seal for damage. Install new if damaged. Lubricate the O-ring seals with petroleum jelly to prevent damage to the O-ring seals.

    Install the sensors.

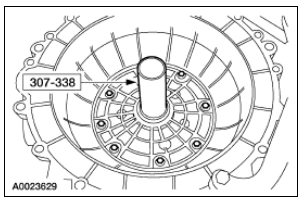


125. ⚠ **CAUTION: The splines of the input shaft are not the same length on both ends. The shaft end with the shorter splines goes into the fluid pump.**

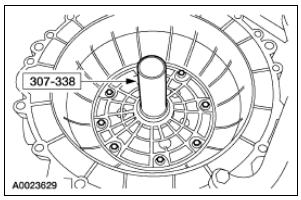
    Install the input shaft.



126. Using the special tool, make sure that the fluid pump gear seal ring is fully seated.



127. Remove the special tool.

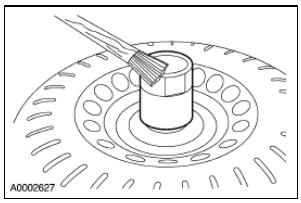


128. **⚠ CAUTION: Do not damage the fluid pump gear O-ring seal when installing torque converter.**

⚠ CAUTION: Make sure the converter hub is fully engaged in the pump support and gear and rotates freely. Do not damage the hub seal.

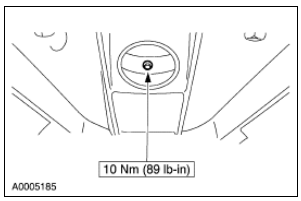
⚠ CAUTION: If the torque converter slides out, the hub seal can be damaged.

Lubricate the converter hub with clean automatic transmission fluid.

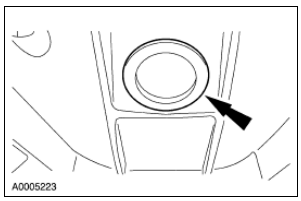


129. **NOTE:** A new converter drain plug must be used to prevent leakage.

Install the drain plug.

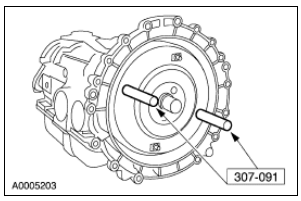


130. Install the converter housing access plug.

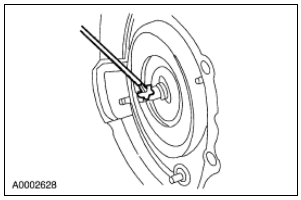


131. **⚠ WARNING: The torque converter can fall out if the transmission is tipped. Failure to follow these instructions may cause personal injury.**

Using the special tools, install the torque converter by pushing and rotating.



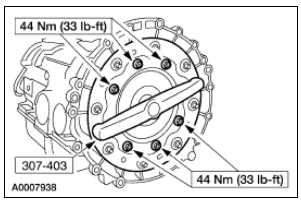
132. Lubricate the torque converter pilot hub with multi-purpose grease.



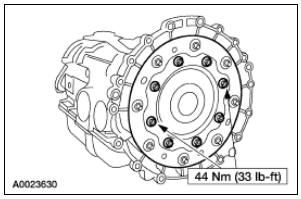
133. ⚠ **CAUTION: The special tool must be used to correctly align the adapter plate to the converter or transmission damage can occur.**

In order to correctly install the special service tool, it must be installed using one round and one oblong hole. Using two oblong holes will cause damage to the transmission.

If the vehicle is equipped, use the special tool to install the torque converter flex plate adapter assembly and eight nuts.

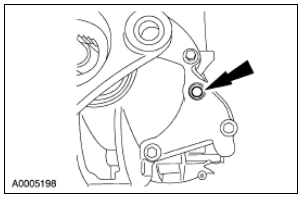


134. Install two torque converter flex plate adapter nuts.

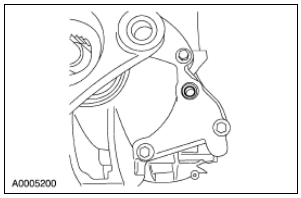


135. **NOTE:** Use the 5/16 inch Allen key to remove the fill plug.

Remove the fill plug.



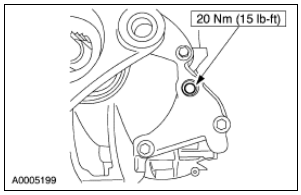
136. Fill the transmission with 8.5L (9 quarts) of clean automatic transmission fluid.



137. ⚠ **CAUTION: When installing the fill plug, make sure not to cross thread the plug to prevent damage.**

    NOTE: Use a 5/16 inch Allen key to install the fill plug.

    Install the fill plug.



138. Before installing transmission, make sure that the transmission cooling system (tube and cooler[s]) have been thoroughly flushed. If contamination cannot be removed or correct flow cannot be obtained, install a new cooler(s) and/or tubes. For additional information, refer to Section 307-02 .

Transmission

Material

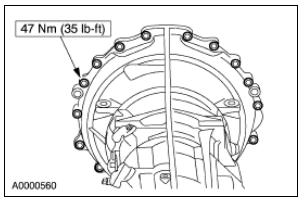
Item	Specification
Premium Long Life Grease XG-1-C	ESA-M1C75-B
Threadlock and Sealer E2FZ-19554-B	WSK-M2G351-A6

1. ⚠ **WARNING: Secure the transmission to the transmission jack with a safety chain. Failure to follow these instructions can result in personal injury.**

   Raise and position the transmission.

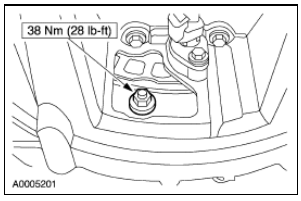
2. **NOTE:** Align the flexplate to converter marks made at removal.

   Install the bolts.

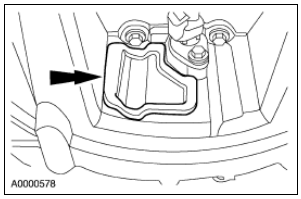


3. **NOTE:** Align the flexplate to converter marks made at removal.

   Align the marks made during removal, and install the nuts.



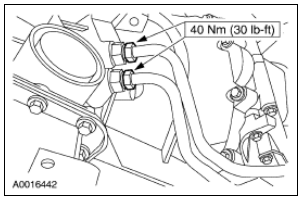
4. Install the access cover.



5. On 3.0L engines only, install the starter motor. For additional information, refer to Section 303-06 .

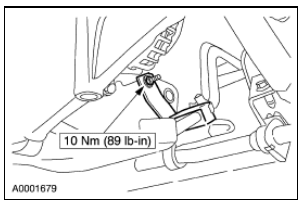
6. ⚠ **CAUTION: Use care not to bend or force the cooler tubes. Otherwise damage to the cooler tubes and the transmission may result.**

Install the transmission cooler tubes.

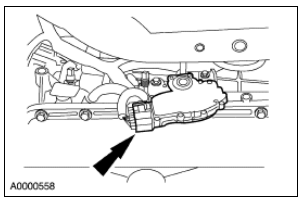


7. **NOTE:** V6 application shown, V8 application similar. The torque specification for the V8 is 18Nm (13 lb-ft).

   Install the transmission cooler line bracket.



8. Reconnect the digital transmission range (TR) sensor connector.



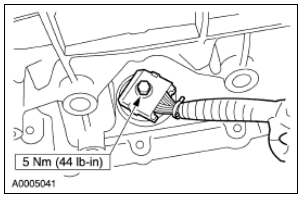
9. ⚠ **CAUTION: Damage will occur to the solenoid body assembly if the screw is tightened above the specification.**

   NOTE: Always install new O-ring seals on vehicle harness connector.

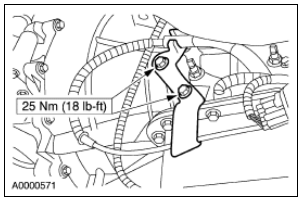
   NOTE: Clean the area around connector to prevent contamination of the solenoid body connector.

   NOTE: Use petroleum jelly to lubricate the O-ring seals to aid in the installation process.

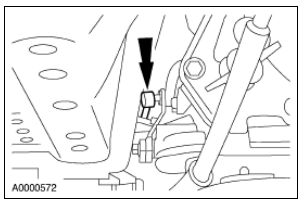
   Install and lubricate new O-ring seals on the transmission connector and connect the connector.



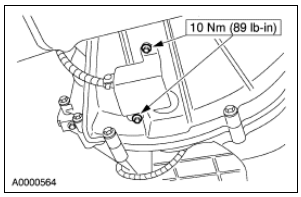
10. Install the shift cable bracket.



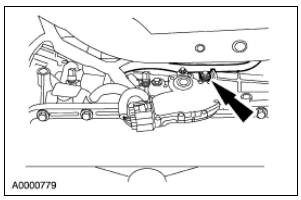
11. Connect the shifter cable.



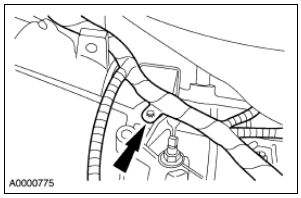
12. Install the heated oxygen sensor (HO2S) connector.



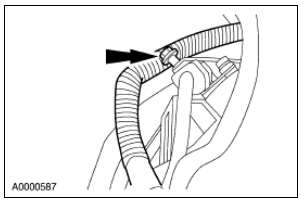
13. Connect the harness retainer.



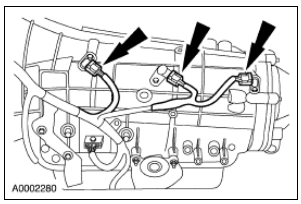
14. Connect the harness retainer.



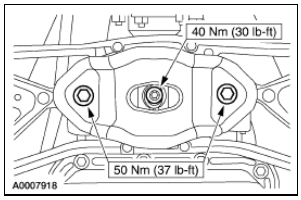
15. Install the harness screw.



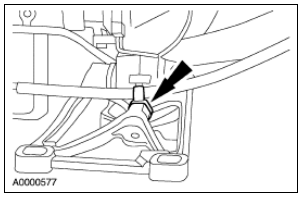
16. Connect the turbine shaft speed (TSS) sensor, output shaft speed (OSS) sensor, and intermediate shaft speed (ISS) sensor electrical connectors.



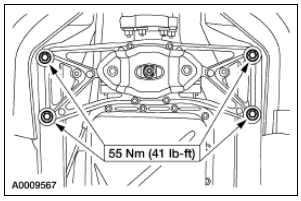
17. Install the rear transmission mount.



18. Install the shift cable.



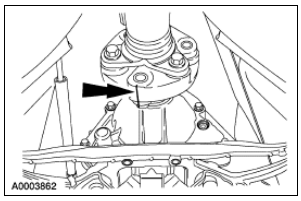
19. Install the rear transmission mount.



20. Remove the transmission jack.

21. ⚠ **CAUTION: Align the index marks, or driveshaft imbalance can occur.**

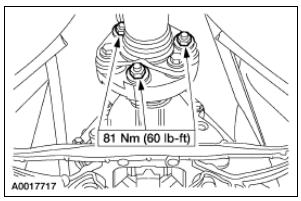
    Align index marks and position the alignment bushing on the transmission flange piloting system.



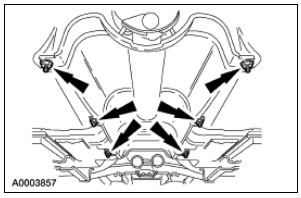
22. ⚠ **CAUTION: Install the bolts, washers and nuts in their original positions, or driveshaft imbalance can occur. Install the driveshaft flex coupling bolts with the head of the bolt seated against the flange, and the nuts seated against the flex coupling. Install the short bolts in the front and the long bolts in the rear.**

    Install the bolts, washers and nuts.

    - Coat the nut and bolt threads with threadlock sealer.

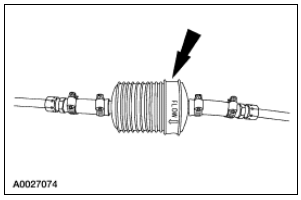


23. Install the exhaust heat shield. For additional information, refer to Section 309-00 .



24. **NOTE:** If the vehicle was not equipped with a fluid filter, install a fluid filter kit. Follow the instructions supplied in the kit. If the vehicle was equipped with a filter, install a new filter.

    Install a new in-line transmission fluid filter kit or filter.



25. Lower the vehicle.

26. **NOTE:** When the battery is disconnected or a new battery installed, certain transmission operating parameters can be lost. The powertrain control module (PCM) must relearn these parameters. During this learning process, you may experience slightly firm shifts, delayed, or early shifts. This operation is considered normal and will not affect the function of the transmission. Normal operation will return once these parameters are stored by the PCM.

    Connect the battery ground cable. For additional information, refer to Section 414-01

27. Raise and support the vehicle. For additional information, refer to Section 100-02 .

28. Carry out the fluid level check. For additional information, refer to Transmission Fluid Level Check in this section.

29. Verify that the shift cable is correctly adjusted. For additional information, refer to Section 307-05 .

30. Check the operation of the transmission and inspect for leaks.

General Specifications

Item	Specification
MERCON® V Automatic Transmission Fluid XT-5-QM	MERCON® V

Torque Specifications

Description	Nm	lb-ft	lb-in
Bolt retaining the transmission fluid cooler to the radiator	10		89
Nut retaining the fluid cooler tube bracket to the stud (V8 engine)	18	13	
Nut retaining the fluid cooler tube bracket to the stud (V6 engine)	10		89
Nut retaining the fluid cooler tube to the transmission	35	26	
Hose clamp retaining the transmission fluid cooler hose to the transmission fluid cooler tube	5		44

Transmission Cooling

The transmission fluid cooler is an oil-to-air (OTA) fluid cooler. The fluid cooler is mounted between the radiator and the A/C condenser.

- When the transmission fluid is cold and the thermostatic valve is closed, the transmission fluid does not circulate through the fluid cooler.
- As the transmission fluid temperature increases, the thermostatic bypass valve opens and allows the transmission fluid to circulate through the fluid cooler.

Transmission Cooling

⚠ CAUTION: Whenever a transmission has been disassembled to install new parts, the transmission fluid cooler must be replaced and the transmission fluid cooler tubes must be cleaned and backflushed.

NOTE: Cleaning and backflushing the transmission fluid cooling system, along with normal cleaning and inspection procedures as outlined in this section during disassembly and reassembly, will keep contamination from reentering the transmission and causing a repeat repair.

When internal wear or damage has occurred in the transmission, metal particles, clutch plate material, or band material may have been carried into the torque converter and transmission fluid cooler. These contaminants are a major cause of recurring transmission troubles and must be removed from the system before the transmission is put back in use.

Inspection and Verification

When fluid leakage is found in the fluid cooler, install a new fluid cooler.

When there is evidence of transmission assembly or fluid contamination due to the following transmission failure modes, install a new fluid cooler.

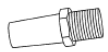
- major metallic failure
- multiple clutches or clutch plate failure
- sufficient component wear which results in metallic contamination

Symptom Chart

Symptom Chart

Transmission Fluid Cooler Flow Test

Special Tool(s)

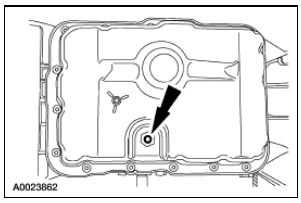
 ST2581-A	Transmission Fluid Fill Tool 307-437

NOTE: The engine idle, transmission linkage/cable adjustment, fluid level and line pressure must be within specification before carrying out this test. Refer to Section 307-05 for adjustments. For additional information on engine idle diagnosis, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. For additional information on fluid level check, refer to Section 307-01 . For additional information on line pressure, refer to Section 307-01 .

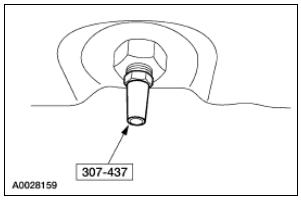
1. Place the transmission range selector lever into PARK.

2. Raise the vehicle on a hoist and place suitable safety stands under the vehicle. For additional information, refer to Section 100-02 .

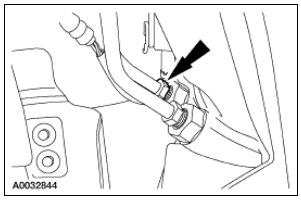
3. Hold the large drain plug with a wrench, and remove the small (center) fluid level indicating plug using a 3/16 inch Allen key.



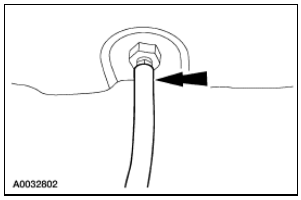
4. Install the special tool into the pan.



5. Remove the cooler return line (upper line) from the fitting on the transmission case.



6. Connect one end of a clear hose to the cooler return line and route the other end of the hose to the special tool in the pan.



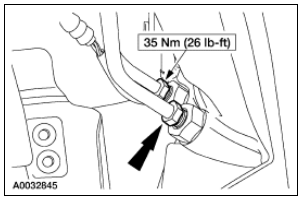
7. Remove the safety stands and lower the vehicle.

8. Start the engine and run it at idle.

9. With the engine running, raise the vehicle on a hoist and place suitable safety stands under the vehicle. For additional information, refer to Section 100-02 .

10. Once a steady flow of fluid (without air bubbles) is observed, remove the hose from the special tool and place the hose in a measuring container for 15 seconds. After 15 seconds, place the hose back onto the special tool. Lower the vehicle and turn the engine off. Measure the amount of fluid in the container. If adequate flow was observed, approximately 237 ml (8 oz) will be in the measuring container. The test is complete. Reconnect the cooler line, and install the fluid fill plug.

11. If the flow is not liberal, disconnect the hose from the cooler return line and connect the hose to the cooler inlet (lower fitting) on the transmission case. Reconnect the cooler return line to the case (upper fitting).



12. Repeat Steps 8-10. If flow is now approximately 237 ml (8 oz) in 15 seconds, the cooler lines and auxiliary cooler must be cleaned. Refer to Transmission Fluid Cooler Backflushing and Cleaning in this section. Carry out this entire test after carrying out the backflushing and cleaning procedure. If, after carrying out the backflushing and cleaning procedure, the flow is still not adequate the installation of new cooler lines and/or auxiliary cooler must be carried out. If the flow from the case is still not adequate after the installation of new cooler lines and/or auxiliary cooler (237 ml [8 oz] in 15 seconds), the pump and/or torque converter may be at fault. Carry out the appropriate procedures for diagnosis and repair in this section.

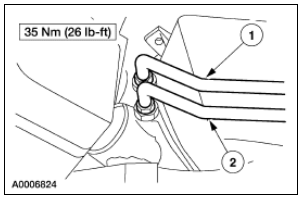
Transmission Fluid Cooler Backflushing and Cleaning

⚠ CAUTION: Whenever a transmission has been disassembled to install new parts or because the valve body sticks from foreign material, the transmission fluid cooler must be cleaned using a suitable torque converter/fluid cooler cleaner. Under no circumstances should torque converters be cleaned by hand agitation with solvent.

When internal wear or damage has occurred in the transmission, metal particles, clutch plate material, or band material may have been carried into the transmission cooler. These contaminants are a major cause of recurring transmission concerns.

1. Using a suitable torque converter/fluid cooler cleaner, backflush the fluid cooler and lines. Test the equipment to make sure that a vigorous fluid flow is present before proceeding. Install a new filter in the flushing equipment if flow is weak or contaminated.

2. To aid in attaching the cleaner to the transmission steel cooler tubes, connect two additional rubber hoses to the transmission end of the steel transmission cooler tubes.
    1. Connect the cleaner tank pressure line to the steel transmission inlet tube.
    2. Connect a tank return hose to the steel transmission outlet tube. Place the outlet end of this hose in the solvent.



3. Turn on the solvent pump and allow the solvent to circulate a minimum of 5 minutes (cycling the switch on and off will help dislodge contaminants in the cooler system).

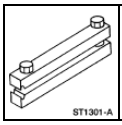
4. Switch off the solvent pump and disconnect the solvent pressure hose from the transmission cooler return line.

5. Use compressed air to blow out the cooler(s) and tubes (blow air into the transmission cooler return line) until all solvent is removed.

6. Remove the rubber return hose from the remaining steel cooler line.

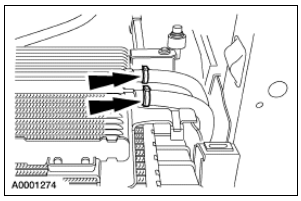
Combination Fluid Cooler

Special Tool(s)

 ST1301-A	Installer, Constant Velocity Joint Boot Clamp 205-343 (T95P-3514-A)

Removal

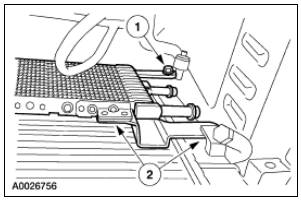
1. Remove the A/C condenser core. For additional information, refer to Section 412-03 .
2. Remove and discard the six hose clamps.



3. **NOTE:** Position a drain pan under the vehicle to catch any fluid that may spill.

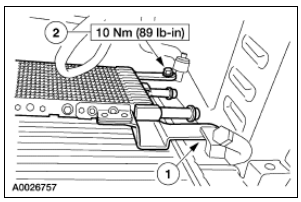
   Disconnect the six hoses from the cooler. Plug the hoses and the cooler.

4. Remove the cooler.
   1. Remove the two bolts.
   2. Lift the cooler from the retainers and remove the cooler.

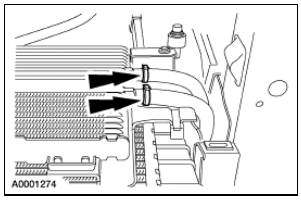


Installation

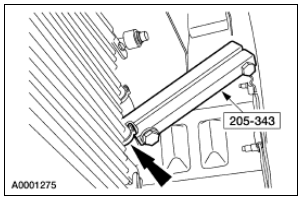
1. Install the cooler.
   1. Position the cooler on the retainers.
   2. Install the two bolts.



2. Position new hose clamps on the six hoses.
3. Remove the plugs from the six hoses and the cooler. Connect the six hoses to the cooler.



4. Using the special tool, tighten the six hose clamps.



5. Install the A/C condenser. For additional information, refer to Section 412-03 .

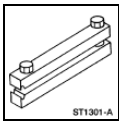
6. Fill and leak check the power steering system. For additional information, refer to Section 211-00 .

7. Fill and leak check the cooling fan system. For additional information, refer to Section 303-03 .

8. Fill the automatic transmission and leak check the cooling system. For additional information, refer to Section 307-01 .

Transmission Fluid Cooler Tubes

Special Tool(s)

 ST1301-A	Installer, Constant Velocity Joint Boot Clamp 205-343 (T95P-3514-A)

Removal

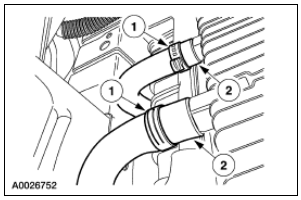
NOTE: This procedure describes the removal and installation of all the transmission cooling system tubes and hoses. Only disconnect those that require removal from the vehicle.

Hose removal

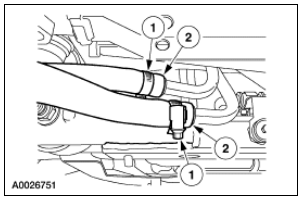
NOTE: Proceed to Disconnecting the tubes in this section if only removing the transmission fluid cooler tubes from the vehicle.

1. Remove the A/C condenser core. For additional information, refer to Section 412-03 .

2. Disconnect the transmission fluid cooler hose from the cooler.
    1. Cut and discard the clamp.
    2. Disconnect the transmission fluid cooler hose from the cooler.



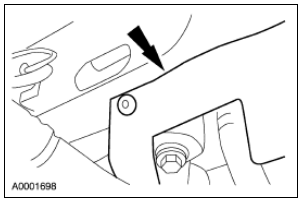
3. Disconnect the transmission fluid cooler hose from the transmission fluid cooler tube.
    1. Loosen and position the clamp aside.
    2. Disconnect the transmission fluid cooler hose from the transmission fluid cooler tube.
        - Proceed to Hose installation in this section if not removing the transmission fluid cooler tubes from the vehicle. Otherwise, proceed as follows.



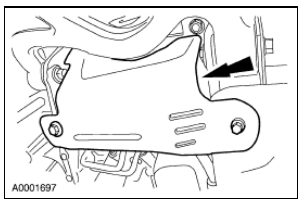
Disconnecting the tubes

4. If not done previously, raise and support the vehicle. For additional information, refer to Section 100-02 .

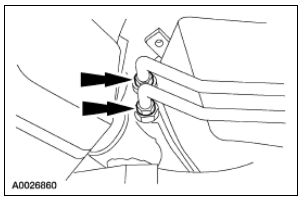
5. If not done previously, remove the LH splash shield pushpin.



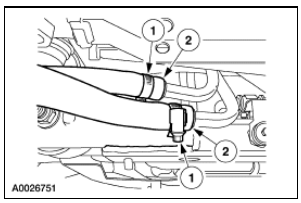
6. If not done previously, remove the bolts and the LH splash shield.



7. Disconnect the transmission fluid cooler tubes from the transmission.

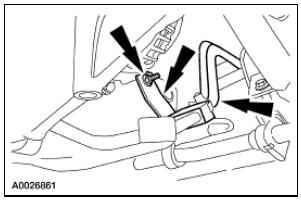


8. If not done previously, disconnect the transmission fluid cooler hoses from the transmission fluid cooler tubes.
    1. Loosen and position the clamps aside.
    2. Disconnect the transmission fluid cooler hoses from the transmission fluid cooler tubes.



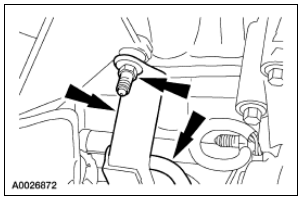
Tube removal, vehicle with V6 engine

9. Remove the nut, the fluid cooler tube bracket, and the fluid cooler tubes.



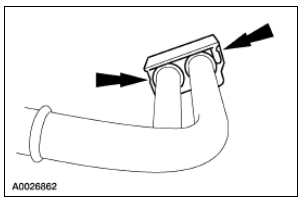
Tube removal, vehicle with V8 engine

10. Remove the nut, the fluid cooler tube bracket, and the fluid cooler tubes.



Routing bracket removal

11. Remove the fluid cooler tube routing bracket from the fluid cooler tubes.

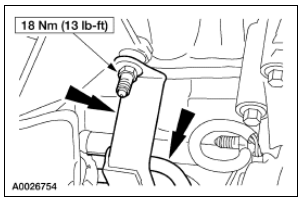


Installation

Tube installation, vehicle with V8 engine

NOTE: Proceed to Hose installation in this section if the transmission fluid cooler tubes were not removed from the vehicle.

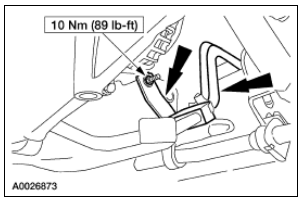
1. Position the transmission fluid cooler tubes and the fluid cooler tube bracket, and install the nut.



Tube installation, vehicle with V6 engine

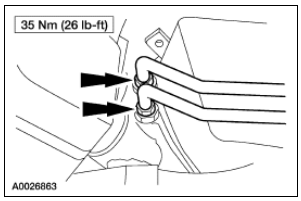
NOTE: Proceed to Hose installation in this section if the transmission fluid cooler tubes were not removed from the vehicle.

2. Position the transmission fluid cooler tubes and the fluid cooler tube bracket, and install the nut.



Connecting the tubes

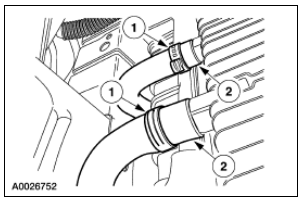
3. Connect the transmission fluid cooler tubes to the transmission.
    - Proceed to Connecting the hose(s) in this section if the transmission fluid cooler hoses were not removed from the vehicle. Otherwise, proceed as follows.



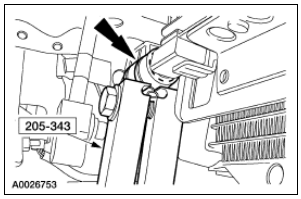
Hose installation

4. Connect the transmission fluid cooler hose(s) to the cooler.

1. Position the clamp on the transmission fluid cooler hose.
2. Connect the transmission fluid cooler hose to the cooler.

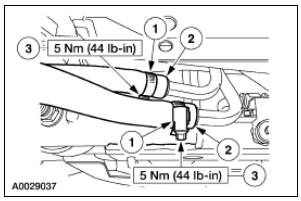


5. Using the special tool, tighten the clamp.
   - Repeat this step for the other hose clamp, if removed.



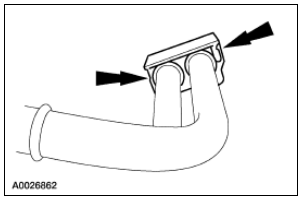
Connecting the hose(s)

6. Connect the transmission fluid cooler hose to the transmission fluid cooler tube.
   1. Position the clamp.
   2. Push the transmission fluid cooler hose onto the transmission fluid cooler tube until bottomed against the stop.
   3. Tighten the clamp.



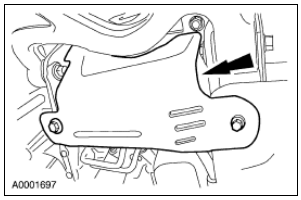
Final assembly

7. If removed, install the fluid cooler tube routing bracket.

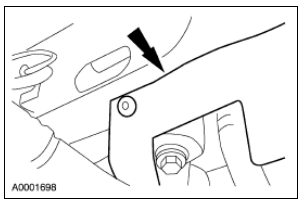


8. If removed, install the A/C condenser core. For additional information, refer to Section 412-03 .

9. Install the LH splash shield and the bolts.



10. Install LH splash shield pushpin.



11. Lower the vehicle.

12. Fill the automatic transmission and leak check the cooling system. For additional information, refer to Section 307-01 .

Torque Specifications

Description	Nm	lb-ft	lb-in
Shifter assembly bolts	7		62
Shift lock actuator bolts	9		80
Transmission shift cable and bracket bolts	27	20	
Screw retaining the lower instrument panel steering column opening cover to the instrument panel	2-3		19-26
Bolt retaining the instrument panel steering column opening cover reinforcement to the instrument panel	3-5		31-45

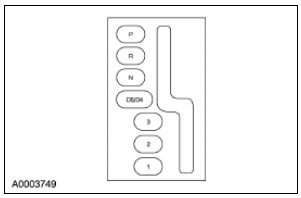
External Controls

The transmission shift cable transfers the transmission operating mode from the transmission range selector lever to the automatic transmission. The indicated position of the lever is transferred to the transmission through the cable and down to the manual control lever on the transmission.

Depending on the vehicle options selected the lever may have different range positions.

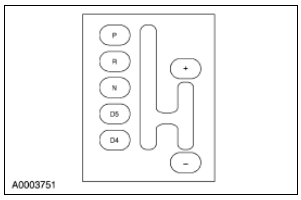
The standard lever has eight positions: P, R, N, D5, D4, 3, 2, and 1.

Base Range Shifter



The optional select shift transmission (SST) range selector lever has seven positions P, R, N, D5, or D4, + and -. The + and - option will allow the driver to manually upshift and downshift into any gear range.

Optional Range Shifter



Brake Shift Interlock System

The shift interlock system prevents shifting the transmission out of the PARK position unless the brake pedal is depressed. The shift interlock system consists of a shift lock actuator mounted on the ignition switch. The actuator is energized when the ignition switch is turned to RUN, locking the transmission range selector lever in the PARK position. When the brake pedal is applied and the brake pedal position (BPP) switch activated, the shift lock actuator is deactivated, allowing the selector lever to move out of the PARK position.

The ignition shift interlock cable locks the selector lever in the PARK position when the ignition switch is in the lock position. It also requires the selector lever to be in the PARK position in order to turn the ignition switch to the lock position.

Select Shift Transmission (SST) Switches (+ and -)

The positions indicated by a (+) or a (-) allow the driver to manually select the appropriate upshift (+) or downshift (-) and gear range.

The SST switches are located within the transmission range selector assembly and are momentary contact switches that send a signal to the powertrain control module (PCM) each time the driver moves the selector lever into the upshift or downshift gear range.

The PCM uses the input signals from the SST+ and the SST- switches, along with other vehicle inputs, to determine which gear should be commanded.

Transmission Control Switch (TCS)

The TCS is a momentary contact switch that sends a signal to the PCM when the driver selects the D4 position, canceling operation of 5th (overdrive) gear.

The TCS is located within the range selector assembly for the base shifter only.

The PCM uses this signal to control the shift solenoids to disengage/disable 5th gear operation and activates coast clutch for the base shifter only. At the same time the PCM changes the instrument panel indicator to display D4.

When the driver moves the selector lever back to the D5 position, 5th gear operation is enabled, the coast clutch is released and the instrument panel indicator displays D5.

Park Sense Switch

The park sense switch prevents the redundant PRNDL from displaying "P" until the shifter is in the PARK position.

Electronic Transmission Error Indicator

The vehicle is equipped with a redundant electronic gearshift indicator. This character appears with the key in the RUN position and displays the same gear selection as shown on the selector lever floor console next to the range selector lever. If an "E" character flashes or remains on this indicates that a transmission malfunction has occurred.

External Controls

Refer to Wiring Diagrams Cell 37 , Shift Lock for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Inspection and Verification

1. Verify the customer concern by operating the transmission external control.
2. Visually inspect for obvious signs of mechanical and electrical damage; refer to the following charts:

   Visual Inspection Chart

Mechanical	Electrical
• Shift lock actuator • Transmission control switch • SST (+/-) switches • Shift cable and bracket • Park sense switch	• Central junction box (CJB) Fuse: ♦ 204 (5A) ♦ 205 (5A) • Damaged wiring harness • Loose or corroded connections • Powertrain control module (PCM)

   Diagnostic Trouble Code Chart

Five Digit DTC	Compo-nent	Description	Condition	Symptom	Action
P0815	SST +/-	SST +/- circuit input signal failed.	PCM has detected an incorrect voltage SST input.	May not be able to shift in manual mode.	Go To Pinpoint Test C .
P1780	TCS	TCS input incorrect per selected position.	TCS voltage incorrect.	No overdrive cancel when range selector is moved.	Go To Pinpoint Test A .

3. If the concern is not visually evident, determine the symptom and proceed to the Symptom Chart.

Symptom Chart

SYMPTOM CHART

Pinpoint Tests

PINPOINT TEST A: OVERDRIVE CANCEL SWITCH NOT WORKING

PINPOINT TEST B: THE PARK SWITCH NOT WORKING

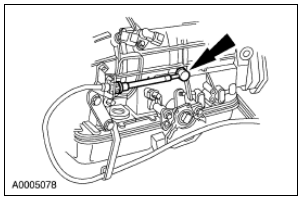
PINPOINT TEST C: THE TRANSMISSION MANUAL SHIFT (+/-) IS INOPERATIVE

PINPOINT TEST D: BRAKE SHIFT INTERLOCK INOPERATIVE

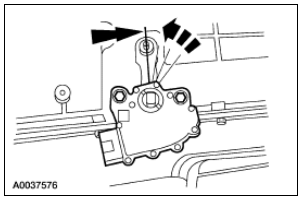
Cable Adjustment

Shift Cable

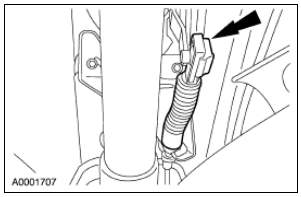
1. Place the gearshift lever (7210) in the D5 position.
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Disconnect the transmission shift cable from the manual control lever (7A256).



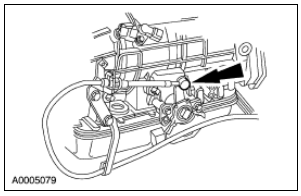
4. Place the manual control lever in the D5 position. This is three positions from the most rearward position.



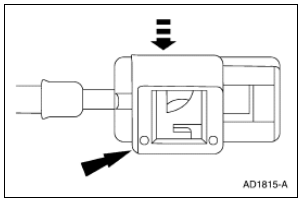
5. Disconnect the transmission shift cable from the selector lever.



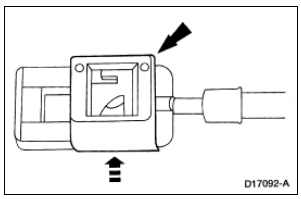
6. Connect the transmission shift cable to the manual control lever.



7. Unlock the adjuster at the end of the cable.



8. Connect the shift cable to the shifter and lock the end of the adjuster.



9. Lower the vehicle.

10. Carefully move the manual control lever from detent to detent and compare with transmission settings. Verify that the vehicle will start in PARK or NEUTRAL and backup lamps illuminate in REVERSE. If not, Steps 1-5 must be repeated and include digital transmission range (TR) sensor adjustment in NEUTRAL. For additional information, refer to Section 307-01 .
    - Adjust as necessary.

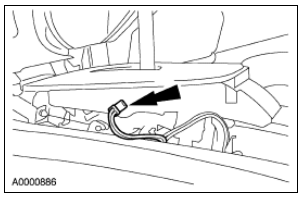
Brake Shift Interlock Actuator

Removal and Installation

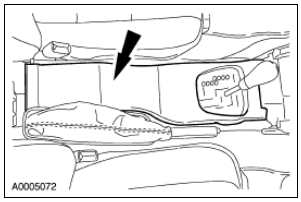
1. **NOTE:** If equipped with the traction control switch, the switch will need to be disconnected prior to removing the center console.

   Remove the center console. For additional information, refer to Section 501-12 .

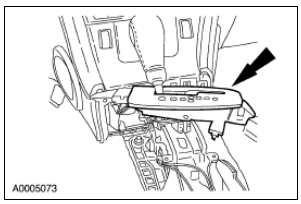
2. Remove the PRNDL indicator bulb.



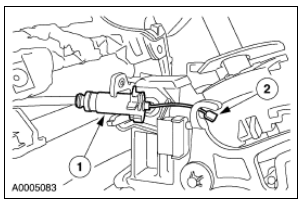
3. Remove the rear A/C air duct.



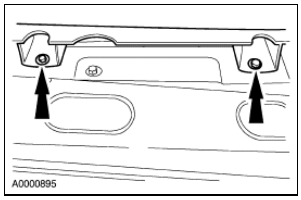
4. Rotate the shifter bezel.



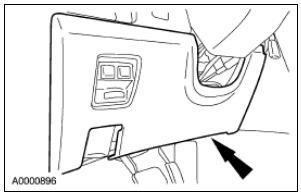
5. Disconnect the cable from the lever.
   1. Remove the shift interlock cable from the bracket.
   2. Disconnect the cable from the lever.



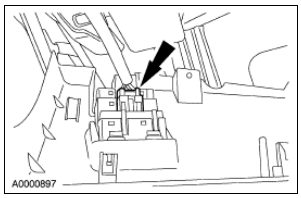
6. Remove the lower steering column cover screws.



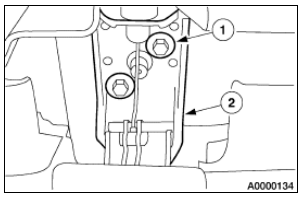
7. Remove the instrument panel steering column cover.



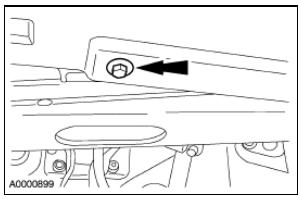
8. Disconnect the electrical connector.



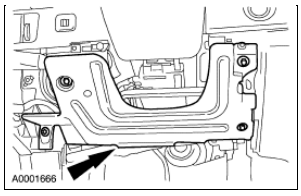
9. Position the hood release cable and bracket aside.
    1. Remove the screws.
    2. Position the hood release cable and bracket aside.



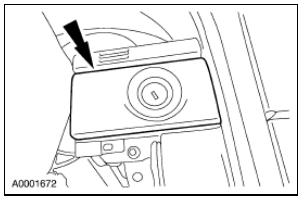
10. Remove the floor heat duct screw.



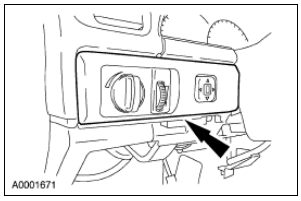
11. Remove the lower reinforcement panel.



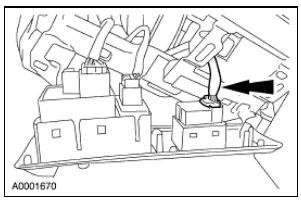
12. Remove the inner instrument panel finish panel.



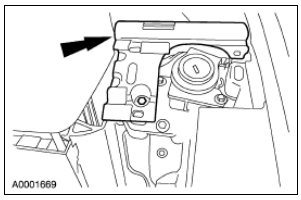
13. Remove the outer instrument panel finish panel.



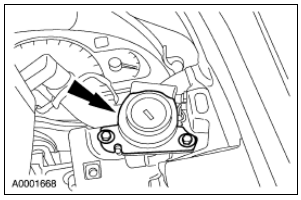
14. Disconnect the power mirror switch.



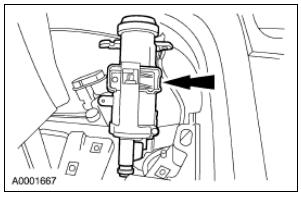
15. Remove the inner trim support panel.



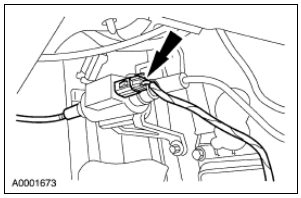
16. Remove the ignition switch.
    - Remove the screws.
    - Remove the ignition switch.



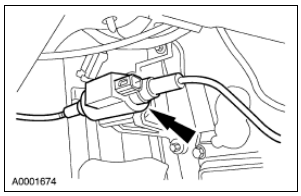
17. Remove two screws for the shift lock actuator cable.



18. Disconnect the electrical connector.



19. Remove the cable from the bracket and remove the cable.



20. To install, reverse the removal procedure.

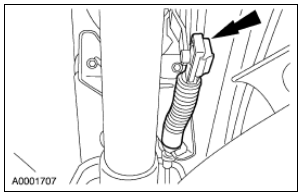
Cable

Removal and Installation

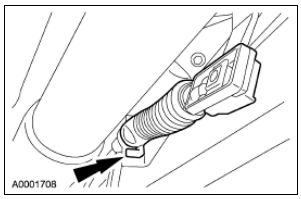
1. Position the gearshift lever in the D-5 position.

2. Raise and support the vehicle. For additional information, refer to Section 100-02 .

3. Disconnect the transmission shift cable from the selector lever.

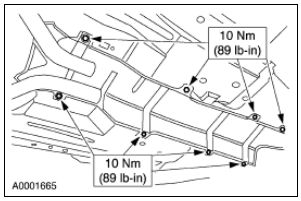


4. Disconnect the transmission shift cable from the bracket.

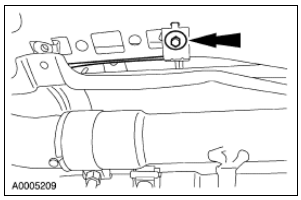


5. **NOTE:** It is not necessary to remove the exhaust.

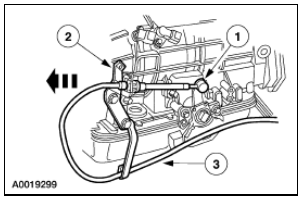
   Remove the bolts from the heat shield and allow the shield to rest on the exhaust.



6. Remove the bolt at the shift cable bracket.



7. Remove the transmission shift cable.
   1. Disconnect the shift cable from the transmission manual control lever.
   2. Depress the tab and slide the shift cable out of the shift cable bracket.
   3. Remove the shift cable.



8. **NOTE:** A cable adjustment must be performed after the installation procedure.

   To install, reverse the removal procedure.

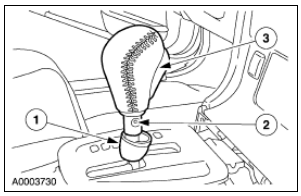
   - Adjust the shifter cable. For additional information, refer to Cable Adjustment in this section.

Selector Lever

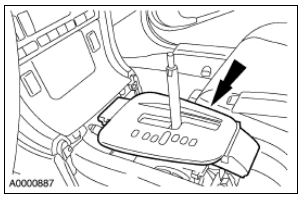
Removal and Installation

1. Remove the center console. For additional information, refer to Section 501-12 .

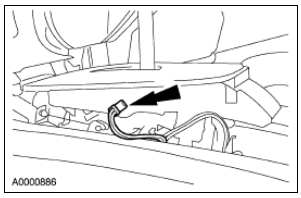
2. Remove the handle and the cover.
    1. Slide the cover down.
    2. Remove the two screws.
    3. Remove the handle and the cover.



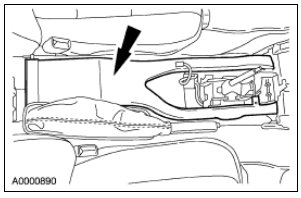
3. Remove the shift bezel.



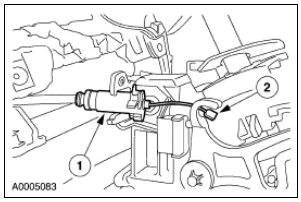
4. Remove the PRNDL indicator bulb.



5. Remove the rear A/C air duct.

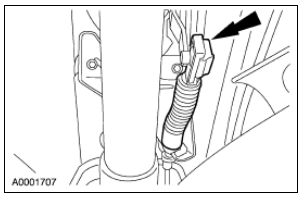


6. Disconnect the cable from the lever.
    1. Remove the shift interlock cable from the bracket.
    2. Disconnect the cable from the lever.



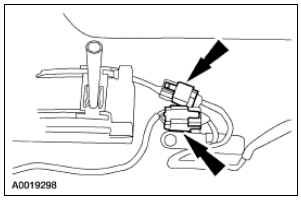
7. Raise and support the vehicle. For additional information, refer to Section 100-02 .

8. Disconnect the transmission shift cable from the selector lever.

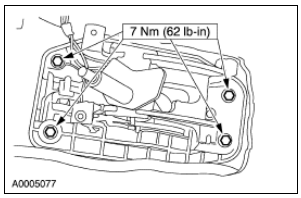


9. Lower the vehicle.

10. Disconnect the two electrical connectors.



11. Remove the shifter assembly.
    - Remove the bolts.
    - Remove the shifter assembly.



12. **NOTE:** A cable adjustment must be performed after the installation procedure.

    To install, reverse the removal procedure.

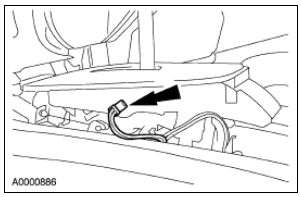
    - Adjust the shifter cable. For additional information, refer to Cable Adjustment in this section.

Transmission Control Switch

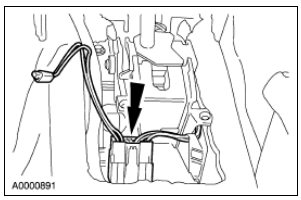
Removal and Installation

1. Remove the center console. For additional information, refer to Section 501-12 .

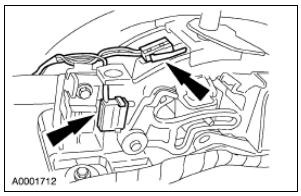
2. Remove the PRNDL indicator bulb.



3. Disconnect the electrical connector.



4. Disconnect the switches and remove the harness.



5. To install, reverse the removal procedure.

Lubricants, Fluids, Sealers and Adhesives

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid C6AZ-19542 AB	ESA-M6C25-A, DOT 3

Manual Transmission and Clutch

The clutch system consists of the following components:

- a flywheel
- a clutch disc
- a clutch pressure plate
- a clutch master cylinder
- a clutch slave cylinder
- a clutch release hub and bearing

The clutch master cylinder transmits fluid pressure to the slave cylinder, which in turn moves the clutch release hub and bearing.

The clutch master cylinder uses brake fluid and shares a common reservoir with the brake master cylinder.

The clutch is a single plate, dry-friction disc with a diaphragm-style spring clutch pressure plate. The clutch disc has a hub which is splined to the input shaft. The clutch disc has friction material where it contacts the flywheel and the pressure plate. The clutch pressure plate applies pressure to the clutch disc, holding it tightly against the surface of the flywheel.

In the engaged position, the diaphragm spring holds the clutch pressure plate against the clutch disc so that engine torque is transmitted to the input shaft. When the clutch pedal is depressed, the clutch release hub and bearing pushes the diaphragm spring center toward the flywheel. The diaphragm spring pivots at the fulcrum, relieving the load on the clutch pressure plate. Steel spring straps riveted to the clutch pressure plate cover pull the clutch pressure plate from the clutch disc, disengaging the engine torque from the transmission and enabling the gears to be changed.

Manual Transmission and Clutch

Inspection and Verification - Clutch

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection Chart

Mechanical
• Transmission oil leak • Loose or missing screws or nuts

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and refer to the Symptom Chart.

Inspection and Verification - Manual Transmission

The following checks should be carried out before repairing or installing a new transmission:

Transmission Noise

If transmission noises are reported, check the transmission fluid level. If damage has occurred due to a lack of fluid, install a new transmission. For additional information, refer to Section 308-03 .

Oil Leakage

- Check that the leaking fluid is actually transmission fluid and not hydraulic fluid (from the hydraulically operated clutch) or engine oil.
- Check the transmission fluid level and, as necessary, drain off any excess fluid.
- Clean the transmission and the adjacent areas carefully before the road test.

Symptom Chart - Poor Gear Shifting

Symptom Chart
Symptom Chart - Oil Leakage

Symptom Chart
Symptom Chart - General Concerns

Symptom Chart

Symptom Chart - Clutch

Symptom Chart

PINPOINT TEST A: CLUTCH SLIPPAGE

PINPOINT TEST B: CLUTCH CHATTER OR SHUDDER

PINPOINT TEST C: CLUTCH DRAG

PINPOINT TEST D: CLUTCH PEDAL PULSATION

PINPOINT TEST E: CLUTCH RELATED VIBRATIONS

PINPOINT TEST F: HARD SHIFTING

PINPOINT TEST G: EXCESSIVE NOISE

PINPOINT TEST H: FLUID LEAKAGE

Bleed Procedure

1. ⚠ **WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.**

   ⚠ **CAUTION: Brake fluid is harmful to painted or plastic surfaces. If the brake fluid is spilled onto a painted or plastic surface, wash it immediately with water.**

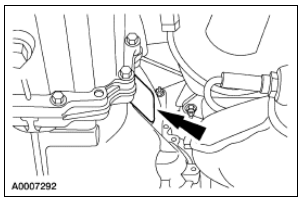
   NOTE: Make sure of absolute cleanliness when filling the brake fluid reservoir.

   NOTE: Do not re-use brake fluid.

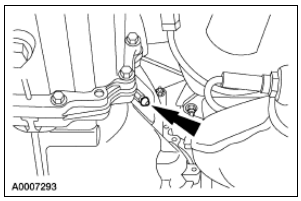
   Fill the brake fluid reservoir with High Performance DOT3 Motor Vehicle Brake Fluid C6AZ-19542-AB or equivalent meeting Ford specifcation ESA-M6C25-A, DOT3.

2. Raise and support the vehicle. For additional information, refer to Section 100-02 .

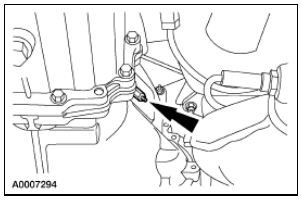
3. Remove the dust cover.



4. Remove the bleed nipple cover.



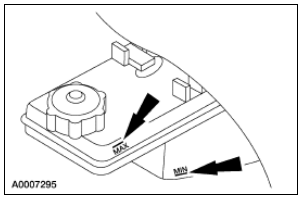
5. Bleed the clutch system.
   - Attach a proprietary bleed jar to the bleed nipple and open the bleed nipple one turn.
   - Depress the clutch pedal repeatedly until the emerging fluid is free of bubbles; always make sure that there is sufficient fluid (5 mm [0.2 in] above the MAX) in the reservoir.
   - After bleeding, tighten the bleed nipple.
   - Install the bleed nipple cover.
   - Install the dust cover.
   - After bleeding, lower the vehicl and depress the clutch 10 times and check that it is functioning correctly.



6. **NOTE:** Make sure of absolute cleanliness when filling the brake fluid reservoir.

   Check the brake fluid level.

   - The fluid level should be between the MIN and MAX marks. If the level drops below the MIN mark, the brake warning indicator will light up.
   - As necessary, fill the brake fluid reservoir with High Performance DOT3 Motor Vehicle Brake Fluid C6AZ-19542-AB or equivalent meeting Ford specifcation ESA-M6C25-A, DOT3.



Release Hub and Bearing Check

1. Turn the clutch release hub and bearing in both directions and check for any binding or abnormal noise.
2. ⚠ **CAUTION: The clutch release hub and bearing is sealed and must not be immersed in any type of cleaning fluid.**

   Check for worn or damaged clutch release hub and bearing fork contact surfaces.
3. Install the clutch release hub and bearing on the input shaft and check for a smooth sliding condition.
4. Check driveshaft splines for rust, scoring, or damage.

Torque Specifications

Description	Nm	lb-ft	lb-in
Flywheel bolts	80	59	
Pressure plate bolts	23	17	

Clutch

The clutch transfers the engine torque to the transmission.

The clutch consists of a disc and a pressure plate with a diaphragm spring, bolted to the flywheel.

When the clutch pedal is operated the power transmission from the engine to the transmission is interrupted. The clutch is therefore engaged when the pedal is not depressed. Pressing down the pedal disengages the clutch.

Clutch

Refer to Section 308-00 .

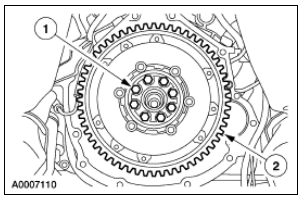
Flywheel

Removal

1. Remove the manual transmission. For additional information, refer to Section 308-03 .

2. Remove the clutch disc and pressure plate. For additional information, refer to Disc and Pressure Plate .

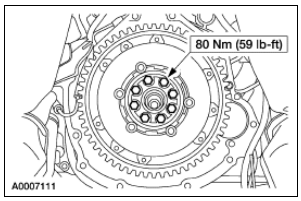
3. Remove the flywheel.
    1. Remove the bolts.
    2. Remove the flywheel.



Installation

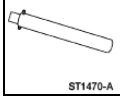
1. **NOTE:** One of the flywheel holes is offset for installation.

    To install, reverse the removal procedure.



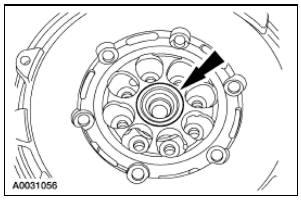
Bearing Pilot

Special Tool(s)

 ST1470-A	Pilot Bearing Replacer 308 105 (T85T-7137 A)

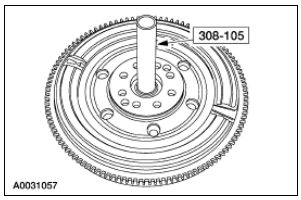
Removal

1. Remove the manual transmission. For additional information, refer to Section 308-03 .
2. Remove the clutch disc and the clutch pressure plate. For additional information, refer to Disc and Pressure Plate in this section.
3. Remove the pilot bearing from the flywheel.



Installation

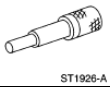
1. Using the special tool, install the pilot bearing into the flywheel.



2. Install the clutch disc and the clutch pressure plate. For additional information, refer to Disc and Pressure Plate in this section.
3. Install the manual transmission.

Disc and Pressure Plate

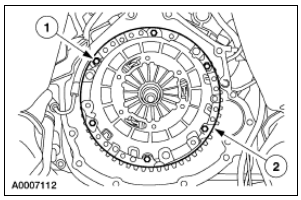
Special Tool(s)

 ST1926-A	Clutch Aligner 308 020 (T74P-7137 K)

Removal

1. Remove the manual transmission. For additional information, refer to Section 308-03 .

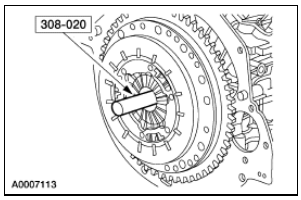
2. Remove the clutch disc and pressure plate.
    1. Remove the pressure plate bolts in a uniform sequence.
    2. Remove the clutch disc and pressure plate.



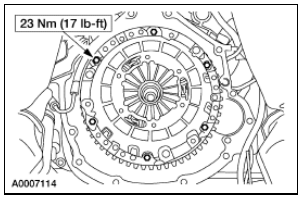
Installation

1. **NOTE:** The clutch disc is marked "Flywheel side" for correct installation.

   Using the special tool, align the clutch assembly.



2. Locate the clutch pressure plate on the flywheel dowels and tighten the bolts in a diagonal sequence.



3. Remove the special tool.

4. **NOTE:** Make sure that the input shaft of the transmission is moved squarely into the hub of clutch disc. Do not bend in any direction.

   Install the manual transmission. For additional information, refer to Section 308-03 .

General Specifications

Item	Specification
Clutch System	
Clutch control	Hydraulic
System adjustment	Automatic
Clutch pedal type	Suspended
Fluid	
High Performance DOT 3 Motor Vehicle Brake Fluid C6AZ-19542-AB	ESA-M6C25-A, DOT 3
Lubricant	
Premium Long-Life Grease XG-1-C, XG-1-K	ESA-M1C75-B
Super Premium SAE 5W-30 Motor Oil	WSS-M2C153 G

Torque Specifications

Description	Nm	lb-ft	lb-in
Slave cylinder-to-transmission bolts	22	16	
Clutch master cylinder nuts	10		89
Hydraulic tube bracket nut	10		89
Clutch pedal position (CPP) switch bracket bolts.	10		89

Clutch Controls

The clutch control system consists of the following components:

- clutch master cylinder reservoir and tubing
- clutch master cylinder
- clutch hydraulic tube

For removal and installation procedures, refer to Section 206-06 .

The clutch control system disengages the clutch when the clutch pedal is depressed and engages the clutch when released. When the clutch pedal is depressed it pushes the clutch master cylinder plunger. This develops hydraulic pressure and applies the clutch slave cylinder which engages the clutch release hub and bearing. The clutch release hub and bearing and clutch pressure plate diaphragm springs release the pressure on the clutch disc. This in turn disengages the transmission from the engine.

The hydraulic clutch system adjusts automatically to compensate for clutch disc wear. The clutch linkage is not adjustable.

Clutch Controls

Refer to Section 308-00 .

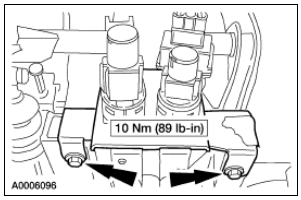
Clutch Pedal

Removal and Installation

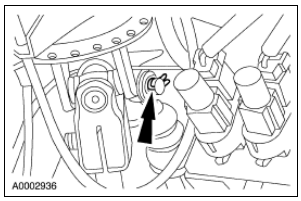
1. **NOTE:** Disconnect the footwell lamp electrical connector.

   Remove the instrument panel insulator.

2. Remove the clutch pedal position (CPP) switch bracket bolts and position the bracket out of the way.

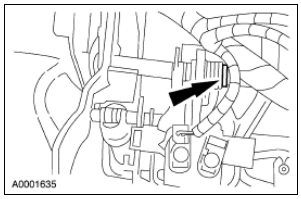


3. Remove the snap ring and disconnect the clutch master cylinder push rod.

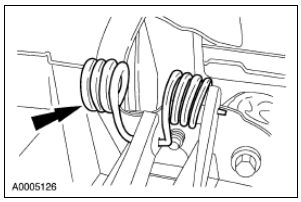


4. **NOTE:** When the clutch pedal shaft is removed from the bracket, the brake pedal, brake and clutch pedal bushings and the spring washer become accessible.

   Remove the clutch pedal snap ring and the clutch pedal shaft.



5. Remove the clutch pedal return spring and the clutch pedal.



6. **NOTE:** Position the return spring in the "V" at the top of the pedal arm.

   NOTE: Before the installation of the clutch pedal shaft or clutch pedal, remove and inspect the brake and clutch pedal bushings. Clean and lubricate with a light film of Super Premium SAE 5W-30 Motor Oil or equivalent meeting Ford specification WSS-M2C153-G and install a new brake and clutch pedal bushing if excessive wear is evident.

To install, reverse the removal procedure.

Clutch Master Cylinder

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid C6AZ-19542-AB	ESA-M6C25-A, DOT 3

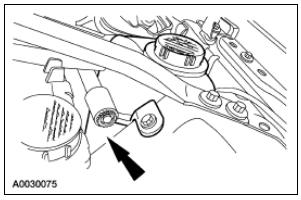
Removal and Installation

1. ⚠ **WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.**

   ⚠ **CAUTION: Brake fluid is harmful to painted or plastic surfaces. If the brake fluid is spilled onto a painted or plastic surface, wash it immediately with water.**

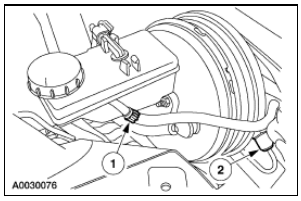
   Remove the hose at the clutch master cylinder reservoir.

2. Remove the degas bottle. For additional information, refer to Section 303-03 .
   - Only partially drain the coolant system.

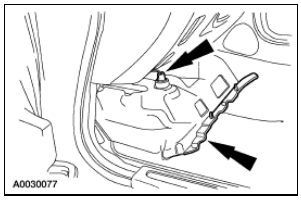


3. Partially drain the brake master cylinder.
   - Drain to just below the clutch reservoir nipple.

4. Remove the clutch hydraulic lines.
   1. Disconnect the reservoir line from the brake master cylinder.
      - ♦ Plug the reservoir line. Discard the hose clamp.
   2. Disconnect the clutch master cylinder hydraulic line.

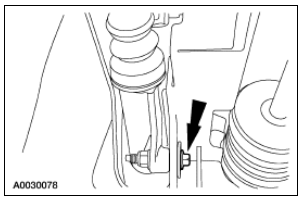


5. Remove the two retainers and lower the instrument panel insulator. Disconnect the footwell lamp electrical connector, then remove from the vehicle.

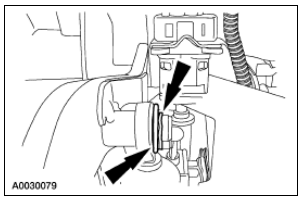


6. Remove the instrument panel finish panel.

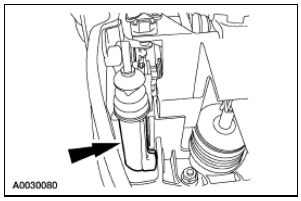
7. Remove the two bolts.



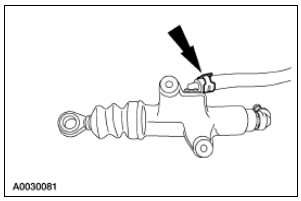
8. Remove the clip and washer from the clutch pedal arm.



9. Disengage the clutch master cylinder from the clutch arm, then remove the clutch master cylinder.



10. Remove the reservoir line from the clutch master cylinder



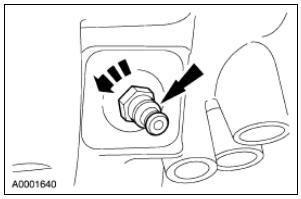
11. To install, reverse the removal procedure.
    - Install new hose clamps on the reservoir line.
    - Refill the brake master cylinder with the specified fluid.
    - Refill the coolant system.
    - Bleed the clutch hydraulic system. For additional information, refer to Section 308-00 .

Slave Cylinder

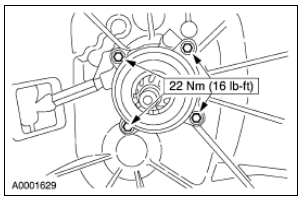
Removal and Installation

1. Remove the transmission. For additional information, refer to Section 308-03 .

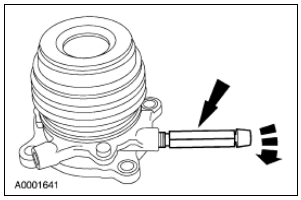
2. Remove the hydraulic tube connector.



3. Remove the bolts and the slave cylinder.



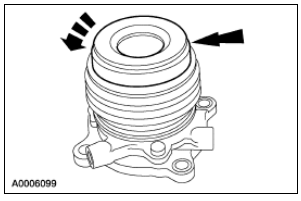
4. Remove the drain tube.



5. ⚠ **CAUTION: The clutch release hub and bearing is pre-lubricated and should not be cleaned with solvent. The clutch release hub and bearing are installed as an assembly. Do not disassemble for inspection.**

   Wipe oil and dirt off the clutch release hub and bearing.

6. Inspect the clutch release hub and bearing as follows:
   - Rotate outer race while applying pressure. If bearing rotation is rough, install a new clutch release hub and bearing.
   - Inspect for any surface scoring or burrs that may impede the sliding motion of the clutch release hub and bearing. Any scoring or burrs should be polished off with a fine grade of emery paper.



7. To install, reverse the removal procedure.

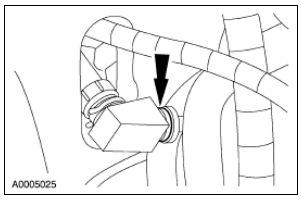
- Bleed the clutch hydraulic system. For additional information, refer to Section 308-00 .

Hydraulic Tubes

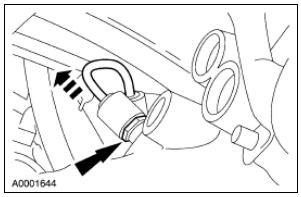
⚠ WARNING: Brake fluid contains polyglycol ethers and polyglycols. Avoid contact with eyes. Wash hands thoroughly after handling. If brake fluid contacts eyes, flush eyes with running water for 15 minutes. Get medical attention if irritation persists. If taken internally, drink water and induce vomiting. Get medical attention immediately.

⚠ CAUTION: Brake fluid is harmful to painted and plastic surfaces. If brake fluid is spilled into a painted or plastic surface, immediately wash it with water.

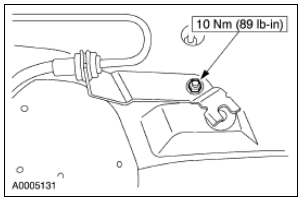
1. Remove the snap ring and tube from the clutch master cylinder connector.



2. Disconnect the clutch slave cylinder hydraulic line.



3. Remove the nut, bracket and hydraulic tube from the vehicle.



4. **NOTE:** Check the clutch slave cylinder port to make sure the old O-ring seal has been removed. Install a new O-ring seal.

   To install, reverse the removal procedure.

   - Bleed the system. For additional information, refer to Section 308-00 .

General Specifications

Item	Specification
Premium Long Life Grease XG-1-K	ESA-M1C75-B

Torque Specifications

Description	Nm	lb-ft	lb-in
Transmission flexible joint bolts	85	63	
Bellhousing bolts	47	35	
Starter motor bolts - 4.0L	25	18	
Transmission support bolts	55	41	
Transmission pinion nut Stage 1	170	125	
Transmission pinion nut Stage 3	120	89	
Support insulator bolt	40	30	
Vehicle speed sensor bolt	11	8	
Transmission drain plug	50	37	
Balance add on nuts	24	18	
Driveshaft yoke lock nuts	90	66	

Manual Transmission

The transmission consists of the following:

- A two part die cast aluminum housing
- Bevel cut gears that rotate on needle roller bearings
- An input shaft and output shaft that rotate on ball bearings
- A layshaft that rotates on roller bearings
- Selector shaft assemblies

The engine rotational torque is transmitted from the crankshaft through the clutch to the transmission input shaft, which then transmits drive to a layshaft and then the output shaft by utilizing an arrangement of gears. When reverse gear is selected, the direction of the output shaft is changed by an idler gear assembly.

In neutral, none of the gears are connected to the input or output shaft through the relevant synchronizer unit. No torque is transmitted to the driveline.

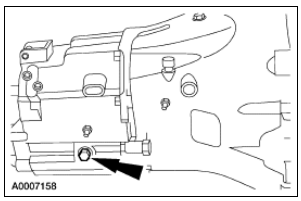
Manual Transmission

Refer to Section 308-00 .

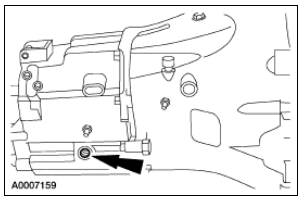
Fill Procedure

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

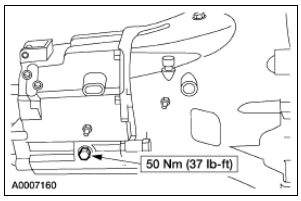
2. Remove the fill plug.



3. Fill the transmission to 0.5 mm (0.02 in) below the lower edge of the fill plug bore.



4. Install the fill plug.

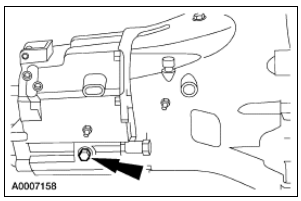


5. Lower the vehicle.

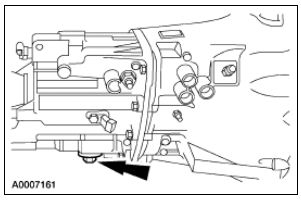
Drain Procedure

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

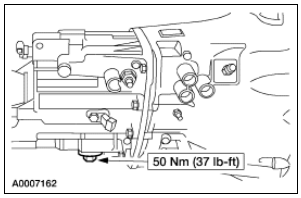
2. Remove the fill plug.



3. Remove the drain plug and drain fluid into a suitable container.



4. Install the drain plug.



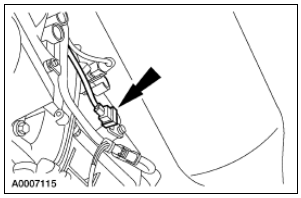
5. Fill the transmission as necessary. For additional information, refer to Fill Procedure in this section.

Vehicle Speed Sensor (VSS)

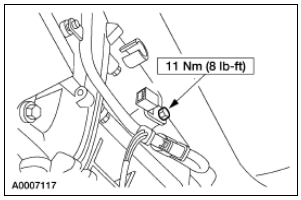
Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Disconnect the vehicle speed sensor (VSS) electrical connector.



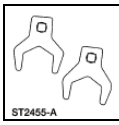
3. Remove the bolt and the VSS.



4. To install, reverse the removal procedure.

Seal Selector Shaft

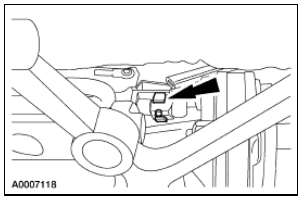
Special Tool(s)

 ST2455-A	Torquing Wrenches, Driveshaft Coupling 205 474

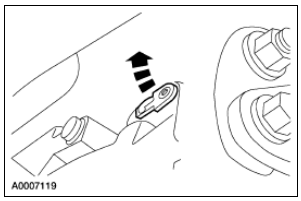
Removal

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Disconnect the selector rod.
   - Remove the selector rod locating pin.

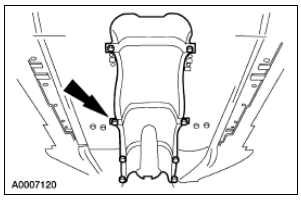

A0007118

3. Disconnect the stabilizer rod.
   - Remove the stabilizer rod locating pin.


A0007119

4. Remove the intermediate muffler. For additional information, refer to Section 309-00 .

5. Remove the bolts and the center heat shield.


A0007120

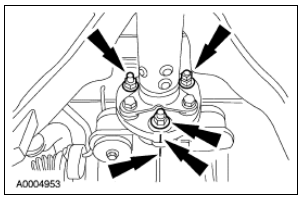
6. **⚠ CAUTION: The transmission flange bolts, nuts, and washers must be removed as matched sets and installed in the original location. The system balance add-on nuts (if equipped) must be installed in the original location.**

   ⚠ CAUTION: Under no circumstances must the flexible coupling (or its fixings) be loosened or removed from the driveshaft

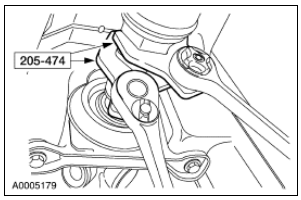
   NOTE: Support the front section of the driveshaft.

Disconnect the transmission flexible joint.

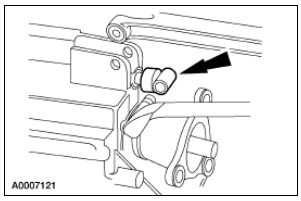
- Mark the position of the driveshaft in relation to the transmission flange.
- Mark the position of each nut and bolt in relation to the transmission flexible joint.



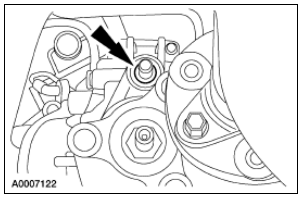
7. Shorten the length of the driveshaft.
   - Using the special tool, loosen the driveshaft locknut and move the driveshaft front section towards the center bearing.



8. Remove the selector rod link.



9. Install a second oil seal over the existing seal.



Installation

1. Install the selector rod link.

2. **NOTE:** Install one gram of Premium Long Life Grease, XG-1-K or equivalent meeting Ford specifications ESA-M1C75-B, in the alignment bushing prior to installation.

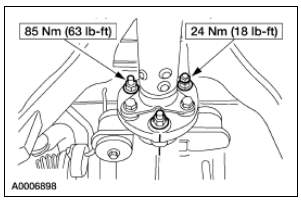
   Slide the driveshaft forward until the flexible coupling engages with the transmission flange.

3. ⚠ **CAUTION: Make sure to match the transmission flange attaching bolts, nuts, washers, and balance add-on nuts (if equipped) in their original locations.**

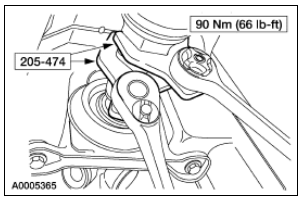
   ⚠ **CAUTION: Tighten the transmission flange bolts and nuts with hand tools only.**

   NOTE: Align the driveshaft index matchmarks.

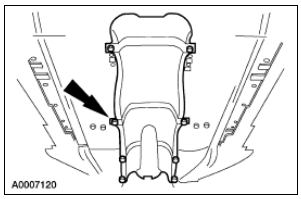
Install the flex coupling bolts, washers and attaching nuts.



4. Using the special tools, tighten the driveshaft yoke locking nuts.



5. Install the bolts and the center heat shield.



6. Install the intermediate muffler.

7. Install the stabilizer rod and stabilizer rod pin.

8. Install the selector rod and the selector rod pin.

9. Lower the vehicle.

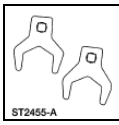
Seal Input Shaft

Removal and Installation

1. Remove the manual transmission. For additional information, refer to Transmission in this section.
2. Remove the clutch slave cylinder. For additional information, refer to Section 308-02 .
3. Remove the input shaft seal.
4. To install, reverse the removal procedure.

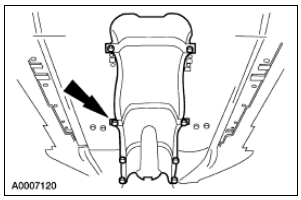
Seal Output Shaft

Special Tool(s)

 ST2455-A	Torquing Wrenches, Driveshaft Coupling 205 474

Removal

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Remove the intermediate muffler. For additional information, refer to Section 309-00 .
3. Remove the bolts and the center heat shield.


A0007120

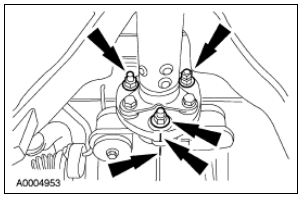
4. **⚠ CAUTION: The transmission flange bolts, nuts, and washers must be removed as matched sets and installed in the original locations. The system balance add-on nuts must be installed in the original locations.**

   ⚠ CAUTION: Under no circumstances must the flexible coupling (or its fixings) be loosened or removed from the driveshaft.

   NOTE: Make sure to disconnect the coupling from the transmission flange only.

   Detach the transmission flexible joint.

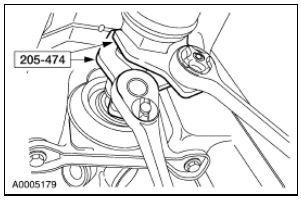
   - Using different color paint markers, place index matchmarks on the transmission flange, driveshaft flexible coupling and the transmission bolts, nuts, washers and add-on nuts, so the driveshaft and the transmission flange can be aligned correctly during installation.


A0004953

5. **NOTE:** Support the front section of the driveshaft.

   Shorten the length of the driveshaft.

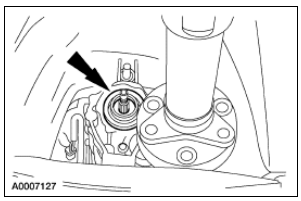
   - Using the special tool, loosen the driveshaft locknut and move the driveshaft front section towards the center bearing.



6. Remove the output shaft flange nut.

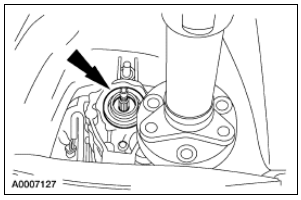
7. Remove the output shaft flange.

8. Remove the output shaft oil seal.



Installation

1. Install the output shaft oil seal.



2. Install the output shaft flange.
   - Stage 1: tighten the nut to 170 Nm (125 lb-ft).
   - Stage 2: loosen the nut by 1/2 turn.
   - Stage 3: tighten the nut to 120 Nm (89 lb-ft).

3. Install the output shaft nut.

4. **NOTE:** Install one gram of Premium Long Life Grease, XG-1-K or equivalent meeting Ford specifications ESA-M1C75-B, in the alignment bushing prior to installation.

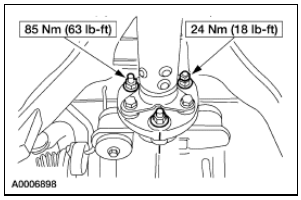
   Slide the driveshaft forward until the flexible coupling engages the transmission flange.

5. ⚠ **CAUTION: Make sure to match the bolts, washers, attaching nuts and balance nuts (if equipped) to their original locations.**

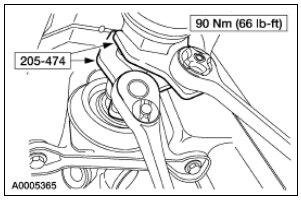
   ⚠ **CAUTION: Tighten the transmission flange bolts and nuts with hand tools only.**

   NOTE: Align the driveshaft index matchmarks.

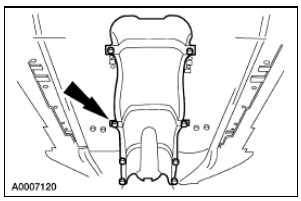
   Install the flex coupling bolts, washers and attaching nuts.



6. Using the special tools, tighten the driveshaft yoke nuts.



7. Install the bolts and the center heat shield.



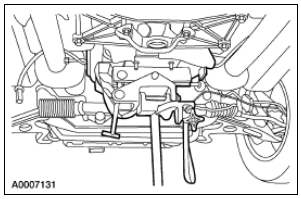
8. Lower the vehicle.

Support Insulator

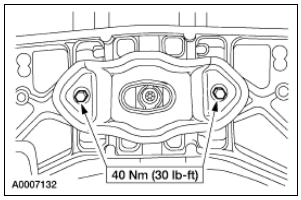
Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

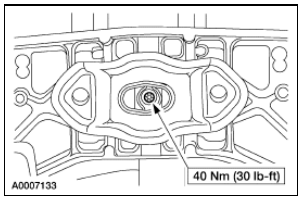
2. Position the transmission jack and install a holding strap around the transmission.



3. Remove the transmission support insulator.



4. Remove the transmission support.



5. To install, reverse the removal procedure.

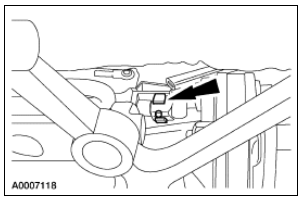
Transmission

Special Tool(s)

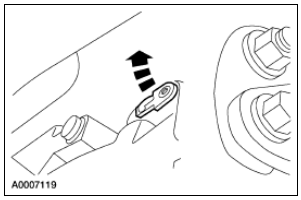
 ST2455-A	Torquing Wrenches, Driveshaft Coupler (Pair) 205-474

Removal

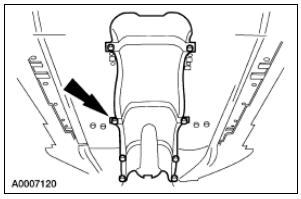
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Remove the starter motor. For additional information, refer to Section 303-06 .
4. Disconnect the selector rod.
   - Remove the selector rod locating pin.



5. Disconnect the stabilizer rod.
   - Remove the stabilizer rod locating pin.



6. Remove the intermediate muffler. For additional information, refer to Section 309-00 .
7. Remove the bolts and the center heat shield.



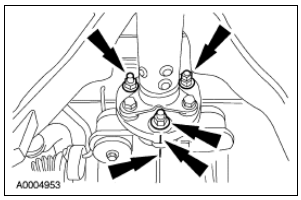
8. **⚠ CAUTION: The transmission flange bolts, nuts and washers must be removed as matched sets and installed in their original location. The system balance add-on nuts (if equipped) must be installed in their original location.**

⚠ CAUTION: Under no circumstances must the flexible coupling (or its fixings) be loosened or removed from the driveshaft.

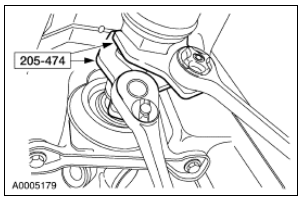
⚠ CAUTION: Support the front section of the driveshaft.

Disconnect the transmission flexible joint.

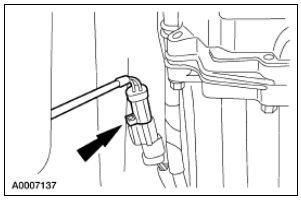
- Using different color paint markers, place index matchmarks on the transmission flange, driveshaft flexible coupling and the transmission bolts, nuts, washer and system balance and on nuts so the driveshaft and transmission flange may be correctly aligned during installation.



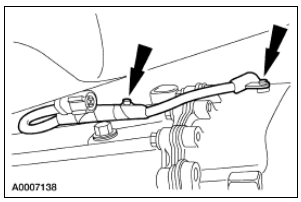
9. Shorten the length of the driveshaft.
   - Using the special tools, loosen the driveshaft yoke locknut and move the driveshaft front section towards the center bearing.



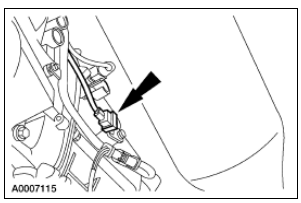
10. Disconnect the right-hand bank catalyst monitor sensor electrical connector.



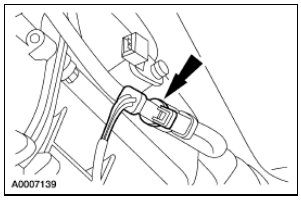
11. Remove the electrical wiring harness from the transmission.



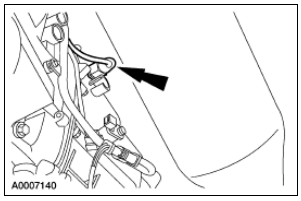
12. Disconnect the vehicle speed sensor electrical connector.



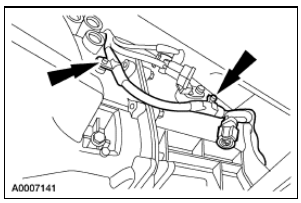
13. Disconnect the left-hand bank catalyst monitor sensor electrical connector.



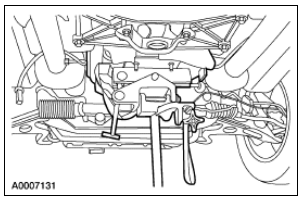
14. Disconnect the reverse light switch electrical connector.



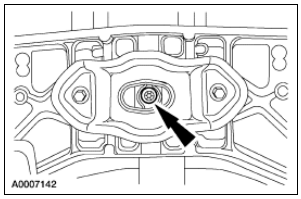
15. Detach the electrical wiring harness from the transmission.



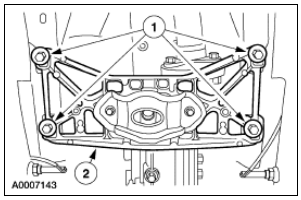
16. Position the transmission jack and install a holding strap around the transmission.



17. Remove the support insulator.



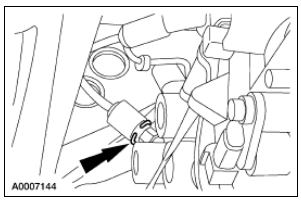
18. Remove the transmission support.
    1. Remove the bolts.
    2. Remove the support.



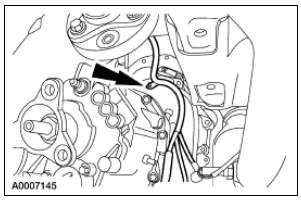
19. Partially lower the transmission.

20. Disconnect the slave cylinder supply tube.
    - Remove the slave cylinder supply tube retaining clip.

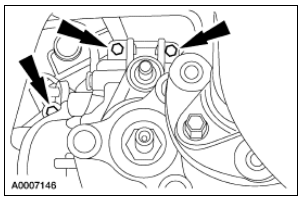
- Plug the hose to prevent loss of fluid.



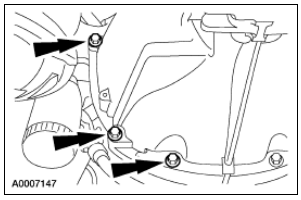
21. Remove the transmission wiring electrical harness from the transmission.



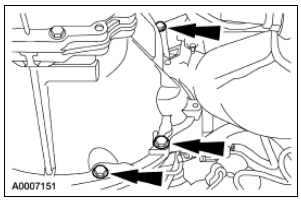
22. Remove the bellhousing bolts.



23. Remove the bellhousing bolts.



24. Remove the transmission.
    - Remove the remaining bellhousing bolts.

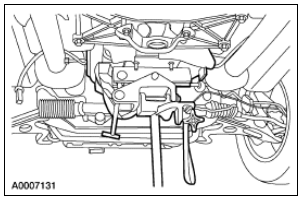


Transmission

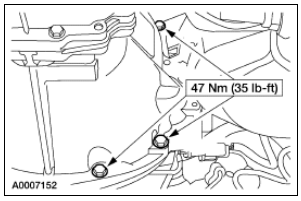
Special Tool(s)

 ST2455-A	Torquing Wrenches, Driveshaft Coupler (Pair) 205-474

1. Position the transmission to the engine using the transmission jack.

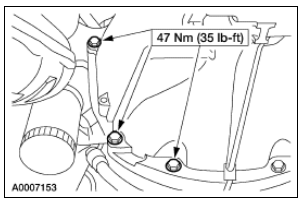

A0007131

2. Install the bellhousing bolts.



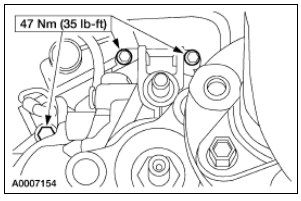
A0007152

3. Install the bellhousing bolts.



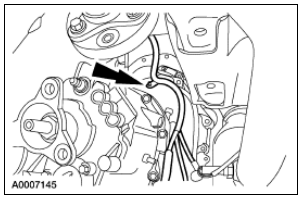
A0007153

4. Install the remaining bellhousing bolts.



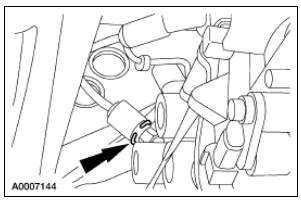
A0007154

5. Attach the transmission wiring harness to the transmission.

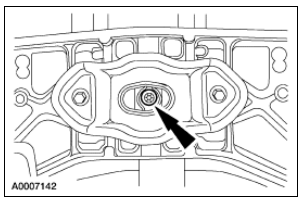

A0007145

6. **NOTE:** Install a new O-ring seal and clip to the supply tube.

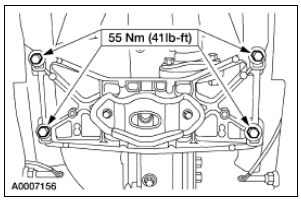
   Connect the slave cylinder supply tube.



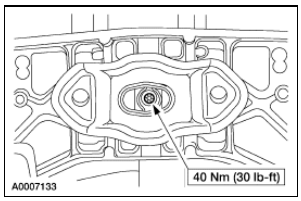
7. Loosely install the transmission support insulator.



8. Install the transmission support.

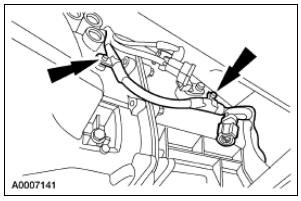


9. Tighten the transmission support insulator center bolt.

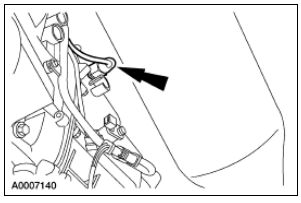


10. Remove the transmission jack.

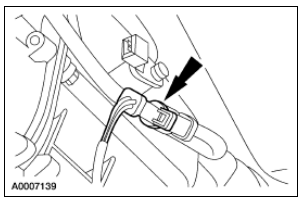
11. Attach the electrical wiring harness to the transmission.



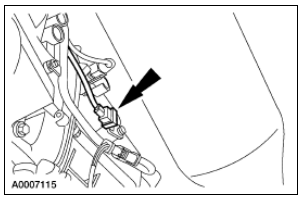
12. Connect the reverse switch electrical connector.



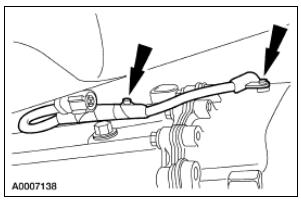
13. Connect the left-hand catalyst monitor sensor electrical connector.



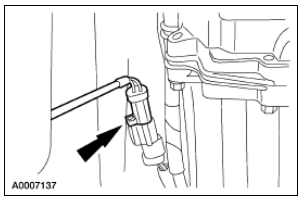
14. Connect the speed sensor electrical connector.



15. Attach the right-hand electrical wiring harness to the transmission.



16. Connect the right-hand catalyst sensor electrical connector.



17. **NOTE:** Install one gram of Premium Long Life Grease, XG-1-K or equivalent meeting Ford specifications ESA-M1C75-B, in the alignment bushing prior to installation.

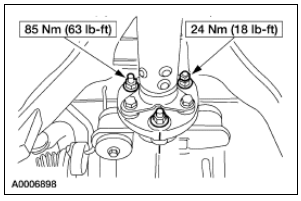
    Slide the driveshaft forward until the flexible coupling engages with the transmission flange.

18. ⚠ **CAUTION: Make sure to match the bolts, washers, attaching nuts and balance add-on nuts (if equipped) to their original location.**

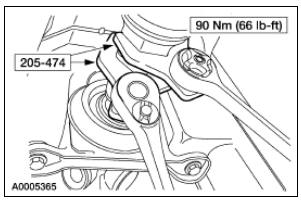
    ⚠ **CAUTION: Tighten the transmission flange bolts and nuts with hand tools only.**

    NOTE: Align the driveshaft index matchmarks.

    Install the transmission flex coupling bolts, washers and attaching nuts.



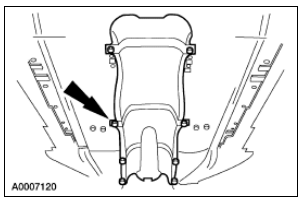
19. Using the special tools, tighten the driveshaft yoke locknuts.



20. Install the stabilizer rod and stabilizer rod pin

21. Install the selector rod and selector rod pin.

22. Install the bolts and the center heat shield.



23. Install the intermediate muffler.

24. Install the starter motor. For additional information, refer to Section 303-06 .

25. Bleed the clutch slave cylinder hydraulic system. For addition information, refer to Section 308-00 .

26. Lower the vehicle.

27. Reconnect the battery ground cable.

General Specifications

Item	Specification
Silicone Lubricant F5AZ-19553	ESR-M13P4 A

Torque Specifications

Description	Nm	lb-ft	lb-in
Three way catalytic converter to exhaust manifold nuts	40	30	
Muffler and resonator assembly nuts	47	35	
Heat shield bolts and nuts	10		89
Worm Clamp	7		62
Muffler brace bolts	25	18	62

Exhaust System

⚠ WARNING: The normal operating temperature of the exhaust system is very high. Never attempt to repair any part of the system until it has cooled. Be especially careful when working around the three way catalytic converter. The temperature of the three way catalytic converter rises to a high level after only a few minutes of engine operation. Failure to follow these instructions may result in personal injury.

⚠ CAUTION: When repairing the exhaust system or removing exhaust components, disconnect all heated oxygen sensors (HO2S) at the wiring connectors to prevent damage to the heated oxygen sensors and wiring harness. For additional information, refer to Section 303-14 for the location of the heated oxygen sensors.

The exhaust system:

- contains dual three way catalytic converters.
- has a crossover pipe downstream of the three way catalytic converters.
- has two upstream heated oxygen sensors mounted before the three way catalytic converters.
- the production muffler and tailpipe assembly is a one-piece design.

Exhaust System

Inspection and Verification

1. Verify the customer concern by running the engine at 2000 rpm or by road testing the vehicle.
2. Visually inspect the components of the exhaust system and the related controls that may affect exhaust gas quality or cause a loss of power.
3. Visually inspect for obvious signs of mechanical and electrical damage. For additional information, refer to the following chart:

   Visual Inspection Chart

Mechanical	Electrical
• Leaking fuel injector tips • Damaged air inlet passages • Inoperative exhaust gas recirculation (EGR) valve • Exhaust pipe pinched, crushed • Damaged, loose vacuum hoses • Incorrect idle speed • Dirty engine air cleaner • Damaged catalytic converter	• Loose heated oxygen sensors • Misrouted, damaged wiring • Damaged, loose connectors • Damaged ignition system

4. Exercise the wiring and connectors of the components for obvious problems due to looseness, corrosion, or other damage. This must be done while the engine is fully warmed and the system controls are activated.
5. Check the vacuum lines and connections for looseness, pinching, leakage, splitting, blockage, or other damage.
6. If a vacuum line or orifice (restrictor) blockage is suspected, correct the cause before proceeding to the next step.
7. If the concern is not visually evident, determine the symptom and proceed to the Symptom Chart.

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: NOISY OR LEAKING EXHAUST

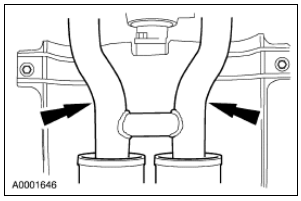
PINPOINT TEST B: LOSS OF POWER

Muffler

Removal and Installation

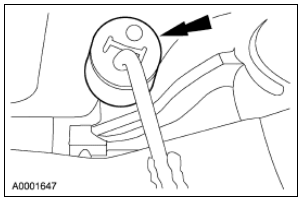
1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Support the exhaust pipes at the rear of the resonators.

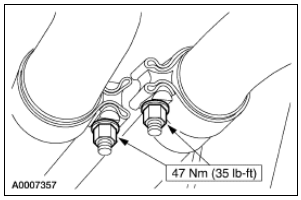


3. **NOTE:** The exhaust hanger bracket insulators can be reused if they show no signs of damage. Lubricate before removal with Silicone Lubricant F5AZ-19553 AA meeting Ford specification ESR-M13P4 A or equivalent.

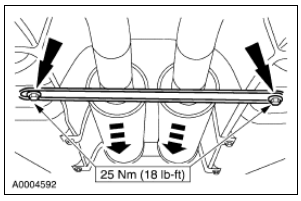
   Remove the exhaust hanger insulators (5F262).



4. Remove the nuts.



5. Remove the bolts, the brace and the mufflers (5230).



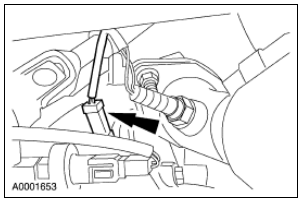
6. To install, reverse the removal procedure.

Catalytic Converter

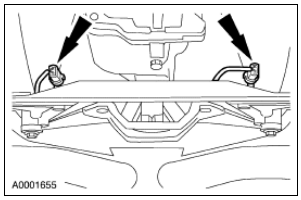
Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

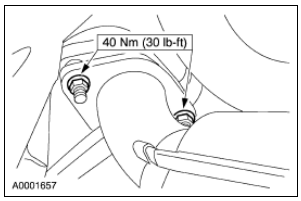
2. Disconnect the two HO2S connectors.



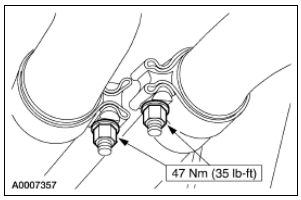
3. Disconnect the two catalyst monitor connectors.



4. Remove the four nuts.



5. Remove the nuts and the three way catalytic converter.



6. Transfer the two HO2S sensors and the two catalyst monitors if a new TWC is being installed.
   - Apply High Temperature Nickel Anti-Seize Lubricant F6AZ-9L494-AA or equivalent meeting Ford specification ESE-M12A4-A to the HO2S sensor and catalyst monitor threads.

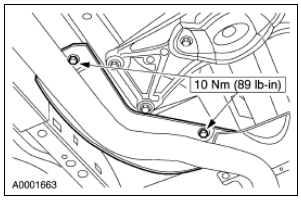
7. To install, reverse the removal procedure.

Exhaust Heat Shield Front

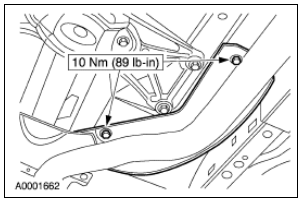
Removal and Installation

1. Raise the vehicle. For additional information, refer to Section 100-02 .

2. Remove the bolts and the LH heat shield.



3. Remove the bolts and the RH heat shield.



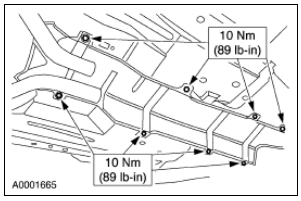
4. To install, reverse the removal procedure.

Exhaust Heat Shield Underbody

Removal and Installation

1. Remove the muffler (5230). For additional information, refer to Muffler in this section.

2. Remove the bolts, the nuts and the heat shield.

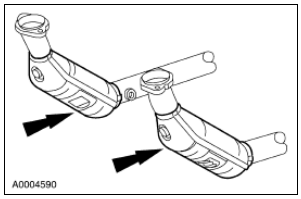


3. To install, reverse the removal procedure.

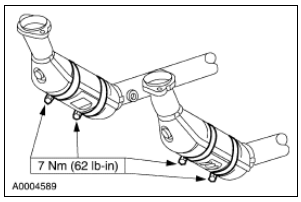
Exhaust Heat Shield Catalytic Converter

Removal

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .
2. Inspect the catalytic converters for loose or missing heat shields.



3. Install worm clamps for heat shields that are loose.



4. If the heat shields are missing, install new heat shields. If new heat shields are not available, install a new catalytic converter. For additional information, refer to Catalytic Converter .
5. Lower the vehicle.

2002 Lincoln LS Contents/Index

-- A --

A/C Clutch Air Gap Adjustment

Acceleration Control

DESC & OPER: Acceleration Control

DIAG & TEST: Acceleration Control

Section Table of Contents

Accelerator Cable Bracket 3.0L

Accelerator Cable

Accelerator Pedal and Shaft

Accelerometer

Accessory Drive Belt Idler Pulley

Accessory Drive Belt 3.0L

Accessory Drive Belt 3.9L

Accessory Drive

DESC & OPER: Accessory Drive

DIAG & TEST: Accessory Drive

Section Table of Contents

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

DESC & OPER: Supplemental Restraint System

DIAG & TEST: Supplemental Restraint System

Air Bag Disposal Deployed

Air Bag Disposal Driver, Undeployed, Scrapped Vehicle

Air Bag Disposal Passenger, Undeployed, Scrapped Vehicle

Air Bag Disposal Side, Undeployed, Scrapped Vehicle

Air Bag Disposal Undeployed Inoperative

Air Cleaner Element

Air Cleaner Outlet Pipe - 3.0L

Air Cleaner Outlet Pipe - 3.9L

Air Cleaner - Inlet

Air Cleaner - Outlet

Air Conditioning (A/C) Compressor Bracket - 3.0L

Air Conditioning (A/C) Compressor - 3.0L

Air Conditioning (A/C) Compressor - 3.9L

Air Conditioning (A/C) Pressure Relief Valve

Air Conditioning (A/C) Pressure Transducer

Air Conditioning (A/C) System Check - Retail Procedure

Air Conditioning (A/C) System Flushing

Air Conditioning (A/C) System Recovery, Evacuation and Charging

Air Conditioning Line (Peanut) Fitting

Air Conditioning

DESC & OPER: Air Conditioning

DIAG & TEST: Air Conditioning

Section Table of Contents

Air Deflector

Air Discharge Temperature Sensor

Air Distribution And Filtering

DESC & OPER: Air Distribution and Filtering

DIAG & TEST: Air Distribution and Filtering

Air Distribution and Filtering, Section Table of Contents

Ambient Air Temperature Sensor

Amplifier - Center Imaging

Antenna Grid Wire Repair

Antenna

DESC & OPER: Antenna

REM & INST: Antenna

Section Table of Contents

Anti-Lock Brake System (ABS) Module - Stability Assist

Anti-Lock Brake System (ABS) Module

REM & INST: Anti-Lock Control - Traction Control

REM & INST: Anti-Lock Control

Anti-Lock Control - Traction Control and Stability Assist, Section Table of Contents

Anti-Lock Control - Traction Control, Section Table of Contents

Anti-Lock Control - Traction Control and Stability Assist

DESC & OPER: Anti-Lock Control - Traction Control and Stability Assist

DIAG & TEST: Anti-Lock Control - Traction Control and Stability Assist

Anti-Lock Control - Traction Control

DESC & OPER: Anti-Lock Control - Traction Control

DIAG & TEST: Anti-Lock Control - Traction Control

Anti-Lock Control

DESC & OPER: Anti-Lock Control

DIAG & TEST: Anti-Lock Control

Section Table of Contents

Anti-Theft - PATS, Section Table of Contents

Anti-Theft - Perimeter, Section Table of Contents

Anti-Theft - Passive Anti-Theft System (PATS)

DESC & OPER: Anti-Theft - PATS

DIAG & TEST: Anti-Theft - PATS

Anti-Theft - Perimeter

DESC & OPER: Anti-Theft - Perimeter

DIAG & TEST: Anti-Theft - Perimeter

Apply Components

Audio System

DESC & OPER: Audio Unit

DIAG & TEST: Audio Unit

DIAG & TEST: Entertainment System General Information

Audio Unit

REM & INST: Audio Unit

Section Table of Contents

Autolamps

Automatic Transaxle/Transmission External Controls, Section Table of Contents

Automatic Transmission 5R55N, Section Table of Contents

Auxiliary Control Steering Wheel Switch

Axle Housing Bushing

Axle Housing

Axle Aluminum

Axle Nodular Iron

SPECIFICATIONS

General Specifications

Item	Specification
Fuel tank capacity	68 liters (18 gal.)
Engine running fuel pressure	207-308 kPa (30-65 psi)
Key on, engine off fuel pressure	207-380 kPa (30-65 psi)
SAE 5W30 Motor Oil XO-5W30-QSP	WSS-M2C153-G

Fuel System

The vehicle:

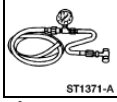
- is equipped with a multiport fuel injection (MFI) system.
- uses separately controlled fuel injectors (9F593) mounted to the intake manifold for each cylinder.
- fuel injectors are supplied with pressurized fuel from the fuel delivery module (9H307) through the jet pump transfer module (9275), through the fuel injection supply manifold (9D280).
- fuel injection supply manifold is controlled by the electronic fuel delivery module which is enabled by the powertrain control module (PCM) (12A650).
- uses an electronic returnless fuel system.
- has a dual-container (saddle type) fuel tank (9002), each half equipped with a fuel level sensor (9A299).
- has a jet pump transfer module (9275) in the left fuel tank half to supply fuel to the right, which contains the fuel delivery module (9H307) that supplies fuel under pressure to the fuel injection supply manifold.
- has an inertia fuel shutoff (IFS) switch (9341), located behind the driver side left foot kick panel, which shuts off the fuel in the event of collision.
- has a fuel system filter (9155), located behind the left front wheel well splash shield.

Fuel System

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Pressure Relief

Special Tool(s)

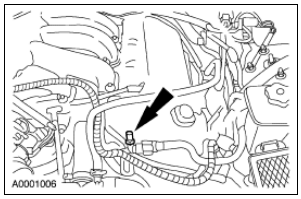
 ST1371-A	Fuel Pressure Gauge 310-012 (T80L-9974-B)

⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

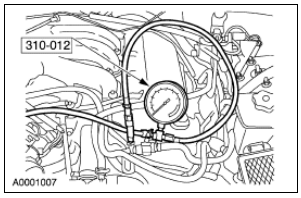
⚠ WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before repairing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

1. **NOTE:** 3.0L shown, 3.9L similar.

   Remove the Schrader valve cap and install the special tool.



2. Slowly open the manual valve on the special tool and relieve the fuel pressure.
   - This will drain some fuel out of the system.



Draining

⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

NOTE: It will be necessary to adapt fuel line connector, part number XW4Z-9B376-AA, to the Fuel Storage Tanker hose to accomplish this draining procedure.

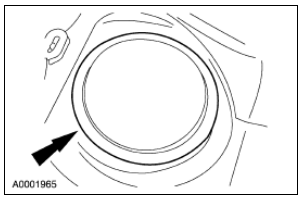
1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Relieve the fuel pressure. For additional information, refer to Pressure Relief in this section.

3. Remove the rear seat bottom and any insulation padding covering the fuel module access cover. For additional information, refer to Section 501-10 .

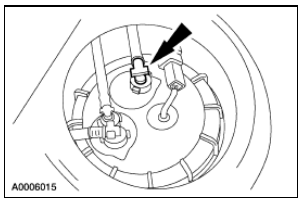
4. Remove the fuel delivery module (FDM) and jet pump module access covers.



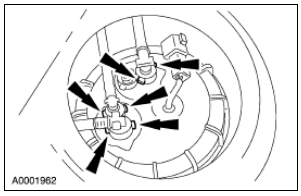
5. **⚠ CAUTION: To disconnect the fuel line connector from the outlet fitting on the module, carefully press down on the fuel line connector while pressing the release tabs. Pull straight up to remove. Failure to follow this procedure could result in damage to the fitting or fuel line.**

   NOTE: Both sides of the tank must be drained individually to make sure all possible fuel is removed from the tank.

   Remove the black connector elbow on the fuel tank crossover lines (jet pump module, LH side).

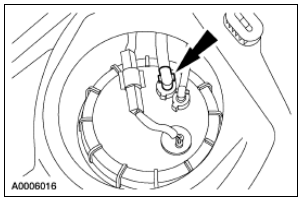


6. Press the release tabs on the module fitting, turn the fuel line slightly, pull straight up to remove the black fuel line connector elbow.



7. Attach the fuel line draining connector to the fuel storage tanker hose and the outlet fitting on the jet pump module. Siphon the fuel until the tank side is empty.

8. Attach the fuel draining connector to the fuel delivery module (FDM) (LH side) and repeat the procedure until the tank is empty. Remove the fuel delivery module and siphon any remaining fuel out of the tank. For additional information, refer to Section 310-01 for fuel delivery module flange removal.



Coupling Spring Lock

Special Tool(s)

 ST1146-A	Spring Lock Coupler Tool (3/8 inch) 310-D004 (D87L-9280-A) or equivalent
 ST1147-A	Spring Lock Coupler Tool (1/2 inch) 310-D005 (D87L-9280-B) or equivalent

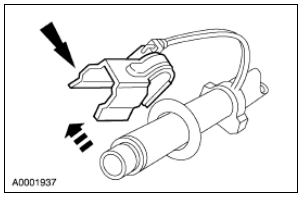
Disconnect

⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

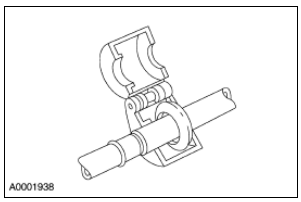
⚠ WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before repairing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

1. Relieve the fuel pressure. For additional information, refer to Pressure Relief in this section.

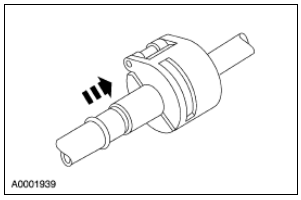
2. Remove the fuel tube clip.



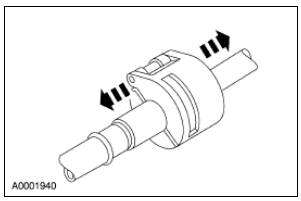
3. Install the special tool.



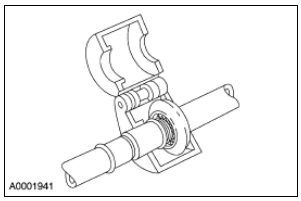
4. Close and push the special tool into the open side of the cage.



5. Separate the fitting.

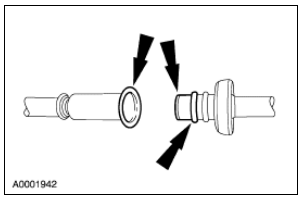


6. Remove the special tool.



Connect

1. Connect the fitting.
    - Inspect and clean both the coupling ends.
    - Lubricate the O-ring seals with clean SAE 5W30 Motor Oil XO-5W30-QSP meeting Ford specification WSS-M2C153-G.
    - Connect the fitting.
    - Pull on the fitting to make sure it is fully engaged.
    - Install the safety clip.



Fittings R-Clip

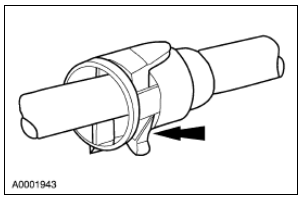
Removal

⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

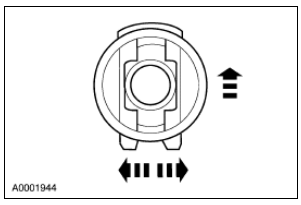
⚠ WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before replacing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

⚠ CAUTION: Do not use any tools. The use of tools may cause a deformity in the clip components which may cause fuel leaks.

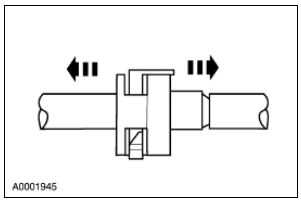
1. Remove the shipping tab by bending it downward.



2. Spread the R-clip legs and push the clip into the fitting.

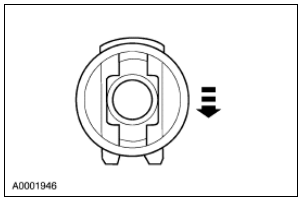


3. Separate the fitting from the tube.

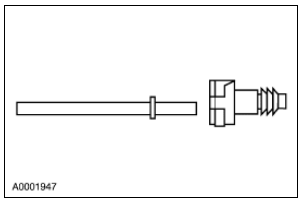


Installation

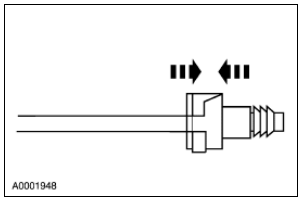
1. Inspect the fitting and the tube for damage. Remove any dirt or obstructions.
2. Apply a light coat of clean SAE 5W30 Motor Oil XO-5W30-QSP meeting Ford specification WSS-M2C153-G to the male tube end.
3. Insert the R-clip into the fitting.



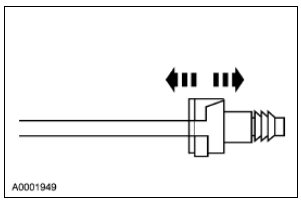
4. Align the tube and the fitting.



5. Insert the tube into the fitting and push together until a click is heard.



6. Pull on the connection to make sure it is fully engaged.



Fittings Vapor Tube

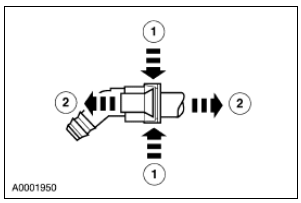
Disconnect

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. **WARNING: The evaporative emission system contains fuel vapor and condensed fuel vapor. Although not present in large quantities, it still presents the danger of explosion or fire.**

   Disconnect the vapor tube from the fitting.

   1. Squeeze the fitting.
   2. Disconnect the vapor tube from the fitting.

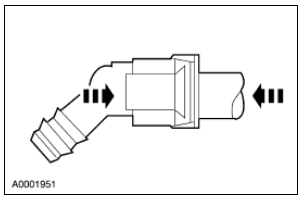


Connect

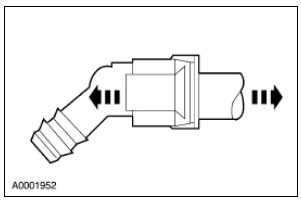
1. Inspect the fitting and the tube for damage.

2. Remove any dirt or obstructions.

3. Push the tube into the fitting until it snaps in place.



4. Pull on the connection to make sure the fitting is secure.



General Specifications

Item	Specification
Capacity	
Fuel tank	68 liters (18 gallons)
Fuel Pressure	
Engine running	207-447 kPa (30-65 psi)
Key on/engine off	207-447 kPa (30-65 psi)
Lubricants	
Surfactant (MERPOL®)	ESE-M99B144-B

Torque Specifications

Description	Nm	lb-ft	lb-in
Exhaust heat shield nuts	10		89
Exhaust heat shield bolts	10		89
Fuel filter mounting bracket bolt	7		62
Fuel tank strap bolts	35	26	
Fuel tank filler pipe bolt	9		80
Fuel delivery module lockring retainer nut	80	59	

Fuel Tank And Lines

The fuel system consists of:

- the fuel tank (9002).
- the fuel tank filler pipe (9034) which contains a restrictor plate to permit only unleaded fuel to be pumped into the fuel tank.
- an 1/8 turn type fuel tank filler cap (9030).
- a fuel filter (9155) providing filtration to protect the fuel injectors.
- an electronic returnless fuel system.
- a single fuel line accommodating the returnless system.
- a fuel transfer pump (9275) which sends the fuel in the left fuel tank lobe to the fuel delivery module (9H307) in the right hand lobe and contains a fuel level sensor.
    - ♦ It has a check valve which maintains system pressure after the pump is shut off.
    - ♦ It is sealed with a gasket.
- a fuel delivery module (9H307) which provides pressurized fuel to the engine and contains:
    - ♦ a fuel level sensor (9A299).
    - ♦ an inlet filter.
    - ♦ The mounting ring is sealed with a gasket.

The fuel pump is controlled by the powertrain control module (PCM) (12A650) which energizes the fuel pump relay. Electrical power to the pump is provided through the inertia fuel shutoff (IFS) switch (9341), which is located in the passenger compartment behind the lower A-pillar trim panel.

Fuel Tank And Lines

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Fuel Tank

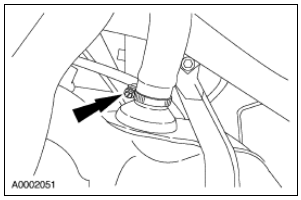
Removal

⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

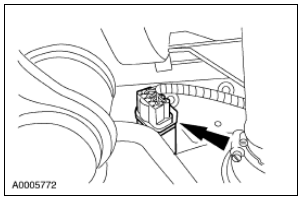
⚠ WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before repairing or disconnecting any of the fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel causing personal injury or a fire hazard.

1. Drain the fuel tank (9002). For additional information, refer to Section 310-00 .
2. Remove the driveshaft. For additional information, refer to Section 205-01 .
3. **⚠ CAUTION: Some fuel will remain in filler pipe after draining the fuel tank. Carefully drain the filler pipe into an approved container.**

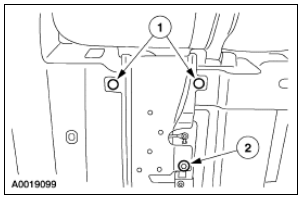
   Loosen the hose clamp at the fuel tank filler pipe and disconnect the filler hose.



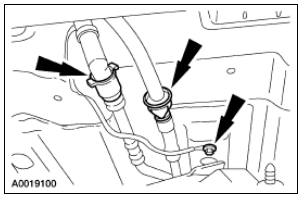
4. Disconnect the fuel tank electrical connector.



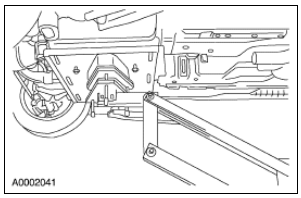
5. Position the fuel line shield aside.
   1. Remove the pin-type retainers.
   2. Remove the bolt.



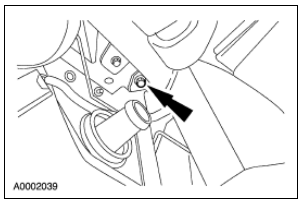
6. Disconnect the fuel delivery line and vapor tube located forward of the fuel tank on the left side.
   - Disconnect the ground strap.



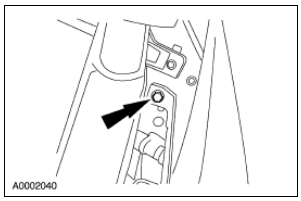
7. Position a suitable lifting device to support the fuel tank.



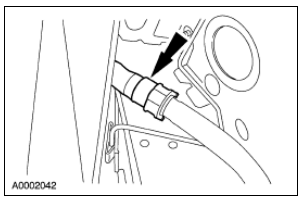
8. Remove the right fuel tank support strap bolt and position the fuel tank support strap aside.



9. Remove the left fuel tank support strap bolt and position the fuel tank support strap aside.



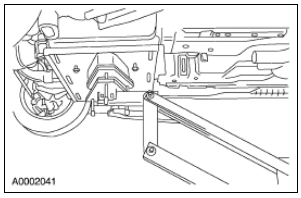
10. Partially lower the fuel tank and disconnect the vapor tube at the top rear of the fuel tank.



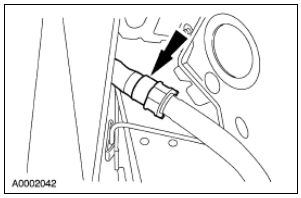
11. Lower the fuel tank.

Installation

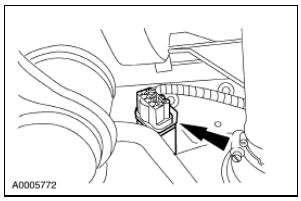
1. Raise the fuel tank slightly below the fully installed position.



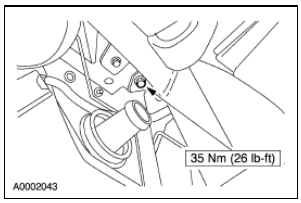
2. Connect the vapor tube at the top rear of the fuel tank.



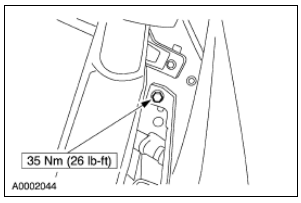
3. Connect the fuel tank electrical connector.



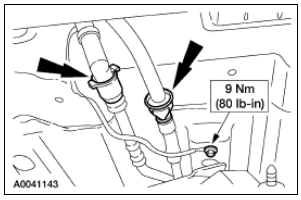
4. Raise the tank into position and install the right support strap and bolt.



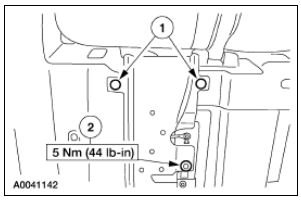
5. Install the left support strap and bolt. Remove the lifting device.



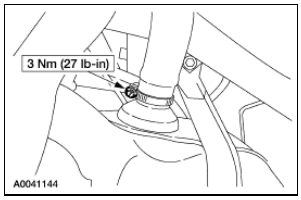
6. Connect the fuel delivery line and vapor tube.
    - Connect the ground strap.



7. Install the fuel line shield.
    1. Install the pin-type retainers.
    2. Install the bolt.



8. Connect the fuel tank filler pipe hose and tighten clamp.

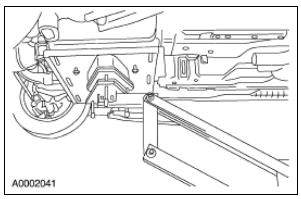


9. Install the driveshaft. For additional information, refer to Section 205-01 .
10. Connect the battery negative cable. For additional information, refer to Section 414-01 .
11. Turn the ignition key to the ON position to pressurize the fuel system.
12. Visually inspect the fuel system for leaks.

Fuel Tank Support Straps

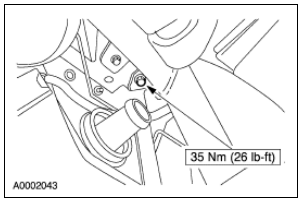
Removal and Installation

1. Position a suitable lifting device to support the fuel tank.

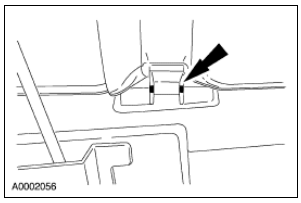


2. **NOTE:** Right support strap and pin shown, left side similar.

   Remove the fuel tank support strap bolt.



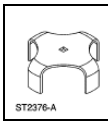
3. Push the strap upward and align the retaining pin with the access hole. Remove the pin and the support strap.



4. To install, reverse the removal procedure.

Fuel Pump Module

Special Tool(s)

 ST2376-A	Wrench, Fuel Tank Sender Unit 310-069

Removal and Installation

⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

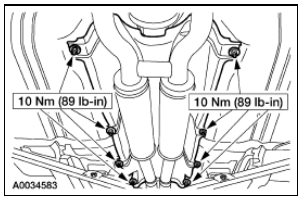
⚠ WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before repairing or disconnecting any of the fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

1. **NOTE:** It is not necessary to remove the fuel tank to carry out this procedure. The Fuel Delivery Module can be accessed under the RH rear seat bottom and access cover.

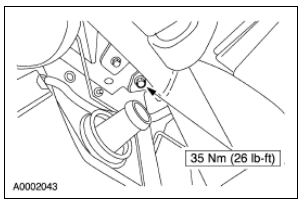
   Drain the fuel tank (9002). For additional information, refer to Section 310-00 .

2. Raise and support the vehicle. For additional information, refer to Section 100-02 .

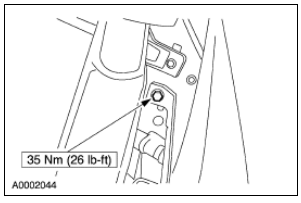
3. Remove the bolts and the nuts and position the exhaust heat shield on the exhaust system.



4. Loosen the right support strap approximately one inch.

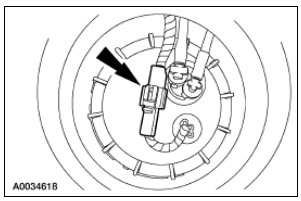


5. Loosen the left support strap approximately one inch.



6. Lower the hoist.

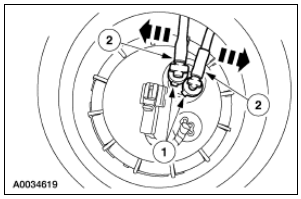
7. Disconnect the electrical connector.



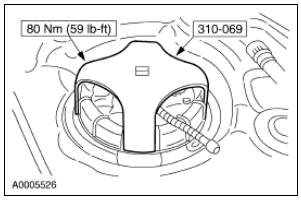
8. **NOTE:** Make sure the fuel line connector is fully seated prior to compressing the release tabs.

   Disconnect the module fuel line connectors.

   1. Press the release tabs on the module fitting.
   2. Turn the fuel line slightly and pull straight up to remove the fuel line connector.

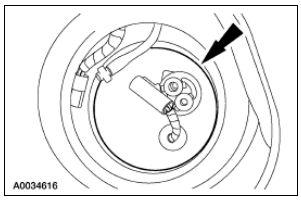


9. Install the special tool and loosen the lockring retainer nut.



10. Continue removing the lockring retainer nut by hand.

11. Lift up on the module top flange and position it aside.

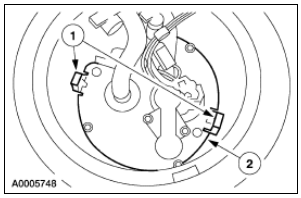


12. ⚠ **CAUTION: The fuel module must be handled carefully to avoid damage to the float arm and the filter during removal.**

    NOTE: The module will contain some residual fuel. Lift straight up and out of the retainer cup and tilt while in tank (float side down) to drain some fuel out of the reservoir. Then straighten and lift straight up and out of the tank. Drain excess fuel into suitable container.

    Remove the fuel delivery module.

    1. Press the lock tabs and release the module from the tank retainer cup.
    2. Remove the module from the tank.

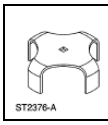


13. **NOTE:** New module assembly flange gaskets must be used. Gently position the module seal by hand and make sure it remains in position during installation. Align the module with the in-tank retaining cup and push down on the module until the latches snap into position onto the cup. Make sure the fuel line tube connectors are fully seated into the outlet connector fittings.

    To install, reverse the removal procedure.

Fuel Transfer Pump

Special Tool(s)

 ST2376-A	Wrench, Fuel Tank Sender Unit 310-069

Removal and Installation

⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

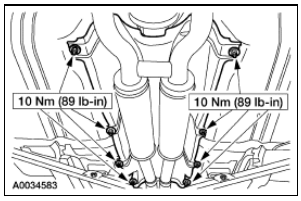
⚠ WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before repairing or disconnecting any of the fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

1. **NOTE:** It is not necessary to remove the fuel tank to carry out this procedure. The Fuel Transfer Pump can be accessed under the LH rear seat bottom and access cover.

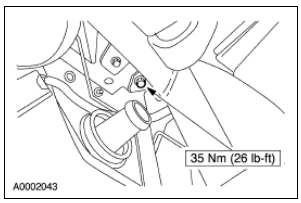
   Drain the fuel tank (9002). For additional information, refer to Section 310-00 .

2. Raise and support the vehicle. For additional information, refer to Section 100-02 .

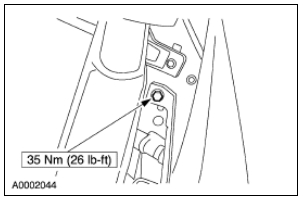
3. Remove the bolts and the nuts and position the exhaust heat shield on the exhaust system.



4. Loosen the right support strap approximately one inch.



5. Loosen the left support strap approximately one inch.

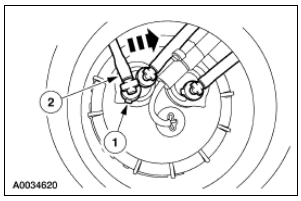


6. Lower the hoist.

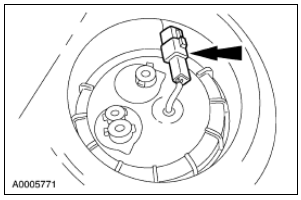
7. **NOTE:** Make sure the fuel line connector is fully seated prior to compressing the release tabs.

   Disconnect the module fuel line connectors.

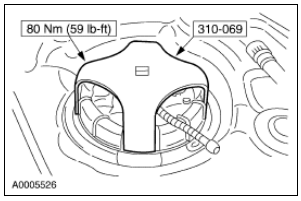
   1. Press the release tabs on the module fitting.
   2. Turn the fuel line slightly and pull straight up to remove the fuel line connector.



8. Disconnect the electrical connector.



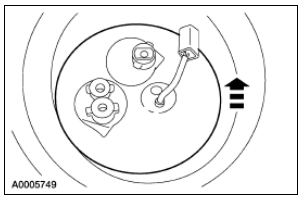
9. Install the special tool and loosen the lockring retainer nut.



10. Continue removing the lockring retainer nut by hand.

11. ⚠ **CAUTION: The fuel module must be handled carefully to avoid damage to the float arm and the filter during removal.**

    Remove the fuel delivery module.



12. **NOTE:** New module assembly flange gaskets must be used. Gently position the module seal by hand and make sure it remains in position during installation. Align the flange tabs with the fuel tank sender opening notches to correctly orient the fuel module. Make sure the fuel line tube connectors are fully seated into the outlet connector fittings.

    To install, reverse the removal procedure.

Fuel Tank Filler Pipe

Material

Item	Specification
MERPOL	ESE-M99B144-B

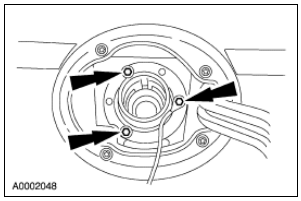
Removal and Installation

⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and can be ignited, resulting in possible personal injury.

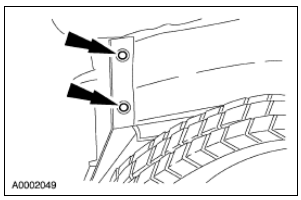
⚠ WARNING: Fuel in the fuel system remains under high pressure, even when the engine is not running. Before repairing or disconnecting any of the fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Relieve the fuel system pressure. For additional information, refer to Section 310-00 .
3. Drain the fuel tank (9002) until it is less than half full. For additional information, refer to Section 310-00 .
4. Remove the fuel filler cap.
5. **NOTE:** The mounting bolt by the hinge retains the fuel cap and tether.

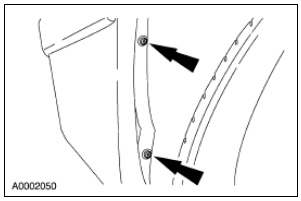
   Remove the bolts at the fuel filler neck housing.



6. Raise the vehicle. For additional information, refer to Section 100-02 .
7. Remove the right rear inner wheel well pin-type retainers securing the splash shield.

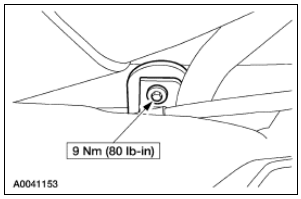


8. Remove the right wheel well screws securing the splash shield.



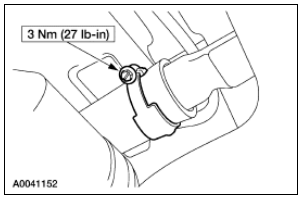
9. **NOTE:** The EVAP mounting tab must be between filler pipe and body.

   Remove the bolt at the filler pipe.



10. ⚠ **CAUTION: Some fuel will remain in filler pipe after draining the fuel tank. Carefully drain the filler pipe into an approved container.**

    Loosen the hose clamp at the fuel tank filler pipe and disconnect the filler pipe.



11. Remove the filler pipe through the wheel well opening.

12. **NOTE:** Lubricate the fuel tank filler pipe end with a lubricant for ease of installation.

    To install, reverse the removal procedure.

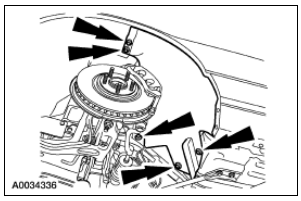
Fuel Filter

Removal and Installation

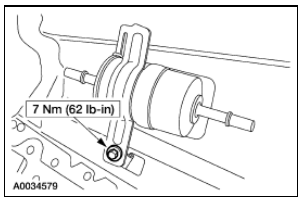
⚠ WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

⚠ WARNING: Fuel in the fuel system remains under high pressure even when the engine is not running. Before repairing or disconnecting any of the fuel system components, the fuel system pressure must be relieved to prevent accidental spraying of fuel, causing personal injury or a fire hazard.

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Relieve the fuel system pressure. For additional information, refer to Section 310-00 .
3. Raise the vehicle. For additional information, refer to Section 100-02 .
4. Remove the left front wheel and tire assembly. For additional information, refer to Section 204-04 .
5. Remove the left wheel well splash shield pin-type fasteners and splash shield.



6. Disconnect the fuel line fittings. For additional information, refer to Section 310-00 .
7. Remove the bolt at the fuel filter bracket and remove the fuel filter (9155).



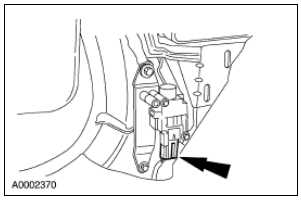
8. If necessary, separate the filter from the bracket for reuse.
9. To install, reverse the removal procedure.

Inertia Fuel Shutoff (IFS) Switch

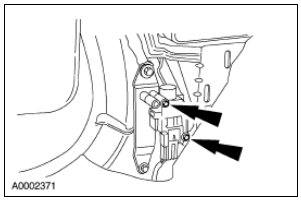
Removal and Installation

1. Remove the left hand lower A-pillar trim panel. For additional information, refer to Section 501-05 .

2. Disconnect the connector from the inertia fuel shutoff (IFS) switch (9341).



3. Remove the screws from the IFS switch and remove the switch.



4. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Accelerator pedal and shaft-to-dash panel bolt and nut	9	80
Accelerator cable bracket bolts	9	80
Accelerator cable housing-to-dash panel bolts	9	80

Acceleration Control

The throttle is controlled by the accelerator cable (9A758) which is connected to the accelerator pedal and shaft (9726).

- The accelerator pedal and shaft should travel smoothly from the idle to the wide-open throttle (WOT) positions. Hesitation on return or prevention of return to the idle position must not occur.
- Surrounding components such as wiring, hoses, sound insulator and floor covering must not contact the sliding inner member of the accelerator cable or the accelerator pedal and shaft.
- The sliding inner member accelerator cable should not be lubricated and is not repairable.

Acceleration Control

Inspection and Verification

NOTE: Care should be exercised when carrying out a repair on or around the accelerator pedal and shaft or controls.

1. Inspect the accelerator pedal and shaft (9726) and the attached accelerator cable for damage or distortion which would bind or limit accelerator travel.

2. Inspect the accelerator cable (9A758) for kinks or fraying which may cause binding.

3. Inspect the engine idle speed adjustment to make sure of correct idle speed specification after any adjustment or repair.

4. Inspect the throttle body (9E926) for excessive wear or damage.

Symptom Chart

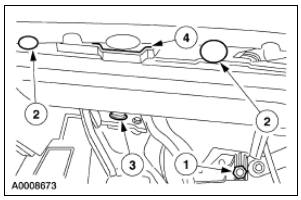
SYMPTOM CHART

Accelerator Pedal and Shaft

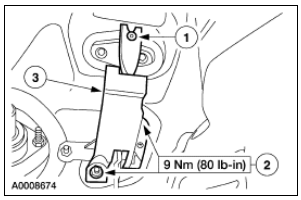
Removal and Installation

NOTE: LH drive shown, RH drive similar.

1. Remove the hush panel.
    1. Remove the nut.
    2. Remove the pin-type retainers.
    3. Disconnect the lamp from the hush panel.
    4. Remove the hush panel.



2. Remove the accelerator pedal and shaft.
    1. Disconnect the accelerator cable from the accelerator pedal and shaft.
    2. Remove the bolt and nut.
    3. Remove the accelerator pedal and shaft.



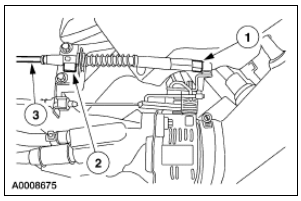
3. To install, reverse the removal procedure.

Accelerator Cable

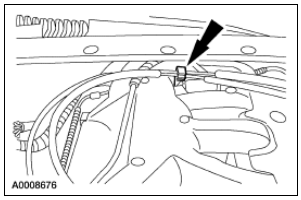
Removal and Installation

NOTE: 3.0L shown, 3.9L accelerator cable bracket is molded into the manifold. LH drive shown, RH drive similar.

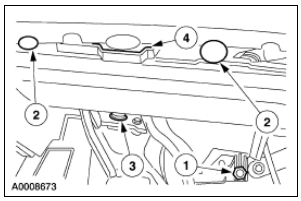
1. Using a trim tool, disconnect the accelerator cable from the throttle body lever and accelerator cable bracket.
    1. Disconnect the accelerator cable from the throttle body lever.
    2. Depress the lock tab and rotate the fitting 90 degrees counterclockwise.
    3. Slide the cable up and out of the bracket.



2. Disconnect the accelerator cable from the retaining clip.



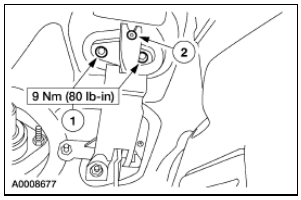
3. Remove the hush panel.
    1. Remove the nut.
    2. Remove the pin-type retainers.
    3. Disconnect the lamp from the hush panel.
    4. Remove the hush panel.



4. ⚠ **CAUTION: Be careful not to kink or nick the cable core wire.**

   Remove the accelerator cable.

    1. Remove the bolts.
    2. Disconnect the accelerator cable and remove.



5. ⚠ **CAUTION: If the accelerator cable is to be reused, inspect the locking tabs of the cable end ball stud fitting. If the locking tabs are damaged or broken, a new accelerator cable must be installed.**

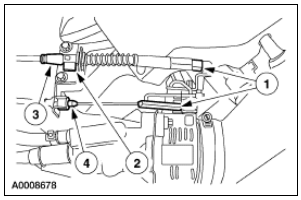
   NOTE: The accelerator cable assembly may be supplied in two pieces. It will be necessary to snap the pieces together prior to installation.

   To install, reverse the removal procedure.

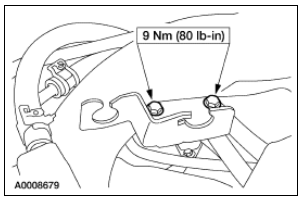
Accelerator Cable Bracket 3.0L

Removal and Installation

1. Disconnect the accelerator cable and speed control cable from the bracket.
    1. Disconnect the accelerator cable and speed control cable from the throttle levers.
    2. Depress the lock tab and rotate the fitting 90 degrees counter clockwise.
    3. Slide the cable up and out of the bracket.
    4. Depress the lock tabs and disconnect the speed control cable from the bracket.



2. Remove the bolts and the accelerator cable bracket.



3. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Bracket to speed control servo bolts	9	80
Bracket mounting bolts	9	80

Vehicle Speed Control

The vehicle speed control consists of the following components:

- powertrain control module (PCM)
- speed control servo
- speed control set telltale
- speed control actuator switches
- deactivator switch
- brake pedal position (BPP) switch
- clutch pedal position (CPP) switch (manual transmission only)
- digital transmission range (DTR) sensor (automatic transmission only)
- speed control actuator cable

Vehicle Speed Control

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool

Refer to Wiring Diagrams Cell 31 for schematic and connector information.

Principles of Operation

The speed control system is designed to maintain a selected vehicle speed between approximately 48 and 200 km/h (30 and 125 mph).

The electronic stepper motor (internal to the speed control servo) is controlled by turning the three phases of the motor ON and OFF in sequence. The sequence determines the motor direction (open throttle or closed throttle based on vehicle speed).

The speed control module is fully integrated into the powertrain control module (PCM). The PCM strategy uses engine control to accelerate smoothly. In instances where the vehicle tends to want to exceed set speed, the PCM will invoke an engine braking strategy to help maintain the desired vehicle speed.

Whenever the system is engaged and active, a speed control set indicator will be illuminated in the instrument cluster.

The brake pedal position (BPP) switch is normally closed to ground. When the brake pedal is applied with the speed control system engaged, the BPP switch closes to battery voltage, putting the vehicle speed control in stand-by mode.

NOTE: The deactivator switch is provided as an additional safety feature.

Normally, when the brake pedal is depressed, the PCM will deactivate the speed control system. Under increased brake pedal effort, the deactivator switch, a normally closed switch, will open and remove power to the speed control servo clutch, releasing the throttle independently of the PCM.

The clutch pedal position (CPP) switch is incorporated on vehicles equipped with manual transmissions. When the clutch pedal is applied with the vehicle speed control system engaged, the normally closed switch opens and signals the PCM to deactivate the speed control.

The air bag sliding contact provides the electrical interface between the steering column wiring and the speed control actuator switches in the steering wheel.

The PCM sends an standard corporate protocol (SCP) output message to the instrument cluster to indicate when the vehicle speed control system is active.

Inspection and Verification

1. Verify the customer concern by operating the speed control to duplicate the condition.

2. Verify the speedometer operates correctly without speed control by test driving the vehicle. If the speedometer does not operate correctly, refer to Section 413-01 .

3. Verify the stoplamps operate correctly with the ignition switch in the OFF position. If the stoplamps do not operate correctly, refer to Section 417-01 .

4. Verify the parking brake is not applied and is operating correctly. If the parking brake is not operating correctly, refer to Section 206-05 .

5. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Speed control actuator cable • Throttle lever • Speed control servo	• Central junction box (CJB) fuse 235 (5A) • Underhood auxiliary junction box (AJB) fuse 106 (15A) • Underhood AJB fuse 118 (40A) • Connections • Pins • Circuitry

6. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel, and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

7. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

8. Carry out the DATA LINK DIAGNOSTIC TEST. If the diagnostic tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for PCM, go to Pinpoint Test A.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out the KOEO Test.

9. If the DTCs retrieved are related to the concern, go to PCM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

10. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.

PCM Diagnostic Trouble Code (DTC) Index

NOTE: DTC P0703 and DTC P1572 must be repaired before any other DTC.

DTCs	Description	Source	Action
P0500	Vehicle Speed Error	PCM	REFER toPowertrain Control/Emissions Diagnosis (PC/ED) manual.
P1565	Speed Control Command Switches High/Out of Range	PCM	GO to Pinpoint Test C .
P1566	Speed Control Command Switches Low/Out of Range	PCM	GO to Pinpoint Test D .
P1567	NGSC Drive Fault	PCM	GO to Pinpoint Test E .
P1568	NGSC Servo Self-Test Failure	PCM	GO to Pinpoint Test F .
P1572	Brake On/Off Failure	PCM	GO to Pinpoint Test G .
P0703	Brake Switch Input Malfunction	PCM	GO to Pinpoint Test G .

Symptom Chart

Symptom Chart
NOTE: Refer to Wiring Diagrams for connector numbers stated in the pinpoint test.

ConditionPossible SourcesAction

- No communication with the powertrain control module (PCM)

- Underhood auxiliary junction box (AJB) fuse 118 (40A).
- Central junction box (CJB) fuses:
  - 204 (5A).
  - 207 (5A).
- Circuitry.
- PCM.

- GO to Pinpoint Test A .

- Unable to enter self-test

- PCM.

- GO to Pinpoint Test B .

- The speed control switch is inoperative no DTCs

- Speed control actuator switch.

- INSTALL a new speed control actuator switch. REFER to Switch Speed Control Actuator in this section.

- The speed control indicator is always on

- Instrument cluster.

- REFER to Section 413-01 .

- The speed control is inoperative no DTCs

- Circuitry.
- Parking brake switch.
- Clutch pedal position (CPP) switch (for manual transmission only).
- Digital transmission range (DTR) sensor (for automatic transmission only).
- Low battery voltage.

- GO to Pinpoint Test H .

Pinpoint Test

PINPOINT TEST A: NO COMMUNICATION WITH THE POWERTRAIN CONTROL MODULE

PINPOINT TEST B: UNABLE TO ENTER SELF-TEST

PINPOINT TEST C: DTC P1565 SPEED CONTROL COMMAND SWITCHES HIGH/OUT OF RANGE

PINPOINT TEST D: DTC P1566 SPEED CONTROL COMMAND SWITCHES LOW/OUT OF RANGE

PINPOINT TEST E: DTC P1567 NGSC DRIVER FAULT

PINPOINT TEST F: DTC P1568 NGSC SERVO SELF-TEST FAILURE

PINPOINT TEST G: DTC P1572, DTC P0703 BRAKE ON/OFF FAILURE

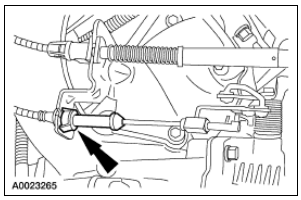
PINPOINT TEST H: THE SPEED CONTROL IS INOPERATIVE NO DTCs

Speed Control Cable

Removal and Installation

1. Remove the speed control servo. Refer to Speed Control Actuator in this section.
2. Lower the vehicle.
3. **NOTE:** 3.9L shown, 3.0L similar.

   Remove the speed control actuator cable from the throttle bracket by squeezing the locking ears.



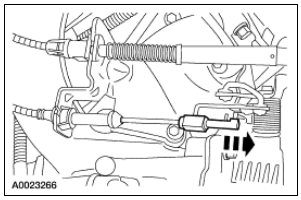
4. To install, reverse the removal procedure.

Speed Control Actuator

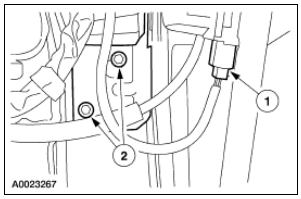
Removal

1. If equipped, remove the engine cover.
2. **NOTE:** 3.9L shown, 3.0L similar.

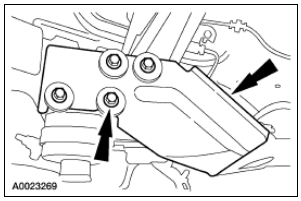
   Detach the speed control actuator cable end from the throttle nailhead by pushing forward.



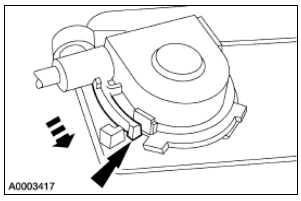
3. Remove the LF wheel and tire. For additional information, refer to Section 204-04 .
4. Remove the LF inner splash shield.
5. Position the speed control servo bracket assembly aside.
   1. Disconnect the electrical connector.
   2. Remove the bolts.



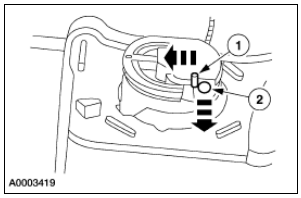
6. Remove the bolts and separate the bracket from the speed control servo.



7. Depress the locking tab and rotate the speed control actuator cable cap to remove.

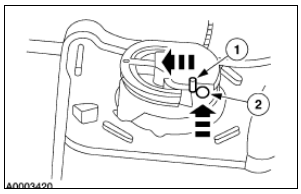


8. Disconnect the speed control actuator cable from the speed control servo pulley.
   1. Gently push the retaining spring.
   2. Disconnect the speed control cable slug from the speed control servo pulley.



Installation

1. Insert the speed control cable slug into the speed control servo pulley slot.
    1. Gently push the retaining spring.
    2. Insert the speed control cable slug completely into the speed control servo pulley slot.

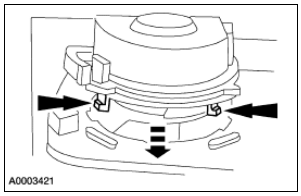


2. **⚠ CAUTION: It is necessary to squarely seat the speed control actuator cable cap and seal around the speed control servo pulley.**

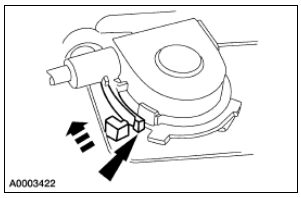
   ⚠ CAUTION: Incorrect wrapping of the speed control actuator cable around the speed control servo pulley may result in high idle conditions.

   NOTE: Make sure the rubber seal is fully seated onto the speed control actuator cable cap.

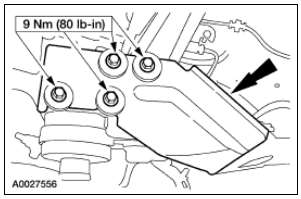
   Align the speed control actuator cable cap tabs with the slots in the speed control servo housing.



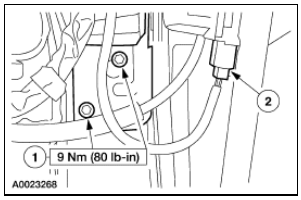
3. Rotate the speed control actuator cable cap until the locking tab engages.



4. Attach the bracket to the speed control servo and install the bolts.



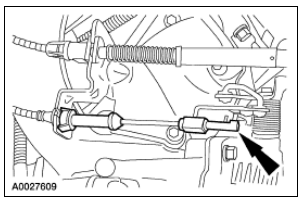
5. Install the speed control servo bracket assembly.
    1. Install the bolts.
    2. Connect the electrical connector.



6. Install the LF inner splash shield.

7. Install the wheel and tire. For additional information, refer to Section 204-04 .

8. Attach the speed control actuator cable end to the throttle nailhead.



9. If equipped, install the engine cover.

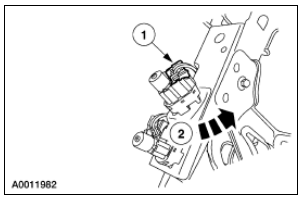
Switch Deactivator

Removal

1. **NOTE:** Disconnect the footwell lamp electrical connector.

   Remove the instrument panel insulator.

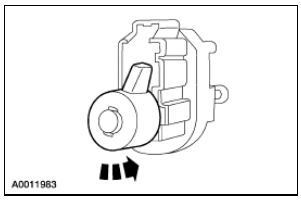
2. Remove the deactivator switch.
   1. Disconnect the electrical connector.
   2. Rotate and remove the deactivator switch.



Installation

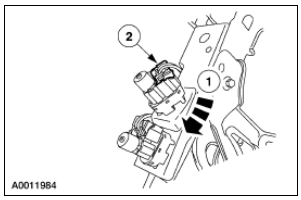
⚠ CAUTION: Initial installation of a deactivator switch allows for one adjustment. If additional adjustments are necessary, install a new switch.

1. Rotate the lock knob counterclockwise to the stop to unlock.



2. With the engine running, fully depress and hold the brake pedal.

3. Install the deactivator switch.
   1. Position the deactivator switch in the bracket and rotate clockwise.
   2. Connect the electrical connector.



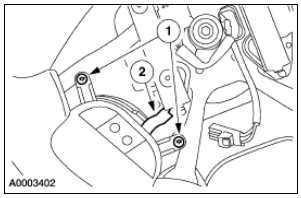
4. Slowly release the brake pedal.

Switch Speed Control Actuator

Removal and Installation

1. Remove the driver side air bag; refer to Section 501-20B .

2. Remove the speed control actuator switch.
    1. Remove the screws.
    2. Disconnect the electrical connector.



3. To install, reverse the removal procedure.

2002 Lincoln LS Contents/Index

-- B --

Battery and Cables

Battery Cables

Battery Disconnect

Battery Tray

Battery

DIAG & TEST: Battery, Mounting and Cables

REM & INST: Battery, Mounting and Cables

Battery, Mounting and Cables, Section Table of Contents

Bearing - Inspection

Bearing - Pilot

Belt Minder Deactivating/Activating

Belt Tensioner

Bleed Procedure

Blend Door Actuator - Air Inlet Door

Blend Door Actuator - Cold Air Bypass Door

Blend Door Actuator - Defrost Door

Blend Door Actuator - Floor Duct Door

Blend Door Actuator - Panel, Floor Console Door

Blower Motor Speed Control

Blower Motor

Body Closures, Section Table of Contents

Body Misalignment Check

Body Sealer Types And Applications

Body System - General Information, Section Table of Contents

Body System

Body

Brake Booster

DESC & OPER: Power Brake Actuation

REM & INST: Power Brake Actuation

Brake Caliper Anchor Plate

Brake Caliper Support Bracket

Brake Caliper

DISASSEM & ASSEM: Front Disc Brake

DISASSEM & ASSEM: Rear Disc Brake

REM & INST: Front Disc Brake

REM & INST: Rear Disc Brake

Brake Disc Machining

Brake Disc Shield

REM & INST: Front Disc Brake

REM & INST: Rear Disc Brake

Brake Disc

REM & INST: Front Disc Brake

REM & INST: Rear Disc Brake

Brake Fluid Reservoir

Brake Master Cylinder

Brake Pads

REM & INST: Front Disc Brake

REM & INST: Rear Disc Brake

Brake Pedal And Bracket

Brake Shift Interlock Actuator

Brake System Bleeding

Brake System Leak Check

Brake System - General Information, Section Table of Contents

Brake System

DESC & OPER: Brake System - General Information

DIAG & TEST: Brake System - General Information

Bulb - Fog Lamp

Bulb - Headlamp

Bumper Cover - Front

Bumper Cover - Rear

Bumper Cover - Trim, Front

Bumper Cover - Trim, Rear

Bumper - Front

Bumper - Rear

Bumpers

DESC & OPER: Bumpers

Section Table of Contents

Bushings, Bearing and Thrust Washer Locator

General Specifications

Item	Specification
Belt Tension [1]	
Limit mm (in)	16 (0.63)
New belt mm (in)	8-10 (0.31-0.39)
Used belt mm (in)	10-12 (0.39-0.47)
Power Steering Gear Operational Specifications	
Type	Rack and Pinion
Ratio	18:1
Static steering wheel turning effort Nm (lb-in)	3.7 (33)
Turning effort kg (lbs)	1.9 (4.1)
Turns of steering wheel [a]	2.9
Power Steering Reservoir	
Air purge vacuum kPa (in-Hg)	68-85 (20-25)
Power Steering Pump	
Flow	2.4 ± 0.2 gpm @ 50 psi & 1,500 rpm
Minimum capacity	1.4 gpm @ 750 psi @ 500 rpm
Relief pressure psi	1,400 1,530
Lubricants	
Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX	MERCON®

[1] Power Steering Pump Belt Deflection (98 N [22 lb] Applied Force)
[a] Lock to Lock-Linkage Disconnected

Steering System

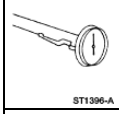
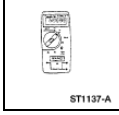
The power steering system consists of the following components:

- power steering pressure lower hose (3F524)
- power steering pressure hose (3E576)
- power steering pump (3A674)
- power steering pump reservoir (3R700)
- power steering reservoir pump hose (3E525)
- power steering return hose (3A713)
- steering gear (3504)

Steering System

Refer to Wiring Diagrams Cell 128 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
 ST1477-A	Power Steering Analyzer 014-00207 or equivalent
 ST1396-A	Dial Thermometer 0-220°F 023-R0007 or equivalent
 ST1137-A	73 III Automotive Meter 105-R0057 or equivalent

Principles of Operation

Variable Assist Power Steering (VAPS)

The VAPS system controls the level of power assistance available to the driver based on vehicle speed. Below 3.2 km/h (2 mph), full power steering assist is provided to lessen steering efforts and increase maneuverability. Between 3.2 km/h (2 mph) and 191 km/h (119 mph), steering assist will decrease gradually at a calibrated rate to raise steering efforts for increased directional stability and greater road feel. Above 191 km/h (119 mph), steering assist is constant.

The front electronic module (FEM) outputs a pulse-width-modulated (PWM) current to the control valve actuator. The control valve actuator controls the hydraulic valve that determines the amount of hydraulic assist provided to the steering gear. The amount of assistance provided varies with the control valve actuator current, which is based on vehicle speed according to a look-up table internal to the FEM. The FEM pulse-width modulates the control valve actuator current to provide the desired amount of assistance. The amount of hydraulic steering assistance provided by the VAPS subsystem is proportional to the average control valve current.

The vehicle speed is provided to the FEM through the standard corporate protocol (SCP) network from the anti-lock brake system (ABS).

The engine rpm is provided to the FEM through the SCP network from the powertrain control module (PCM). The FEM uses the engine rpm to determine if the engine is running. The FEM will only output control valve actuator current when the engine is running to minimize noise, vibration, or harshness when the engine is off. The FEM will assume the engine is running only if the engine rpm is greater than 100 rpm.

Upon engine start, the FEM will provide a 200 millisecond full-on pulse followed by a 150 millisecond full-off pulse to the control valve actuator. Normal VAPS system operation will begin after this cleaning

stroke is complete. In an event that the rpm signal is invalid from the PCM (less than 100 rpm), and the vehicle speed is less than 1.6 km/h (1 mph), the VAPS system will not carry out the cleaning stroke or apply current to the control valve actuator. When the engine speed exceeds 100 rpm, the system carries out the cleaning stroke and begins applying calibrated current to the actuator.

Inspection and Verification

⚠ CAUTION: Do not hold the steering wheel (3600) at the stops for an extended amount of time. Damage to the power steering pump (3A674) can result.

NOTE: Make the following preliminary checks before repairing the steering system:

NOTE: The FEM must be reconfigured upon replacement; refer to Section 418-01 .

1. Verify the customer concern by operating the steering system.

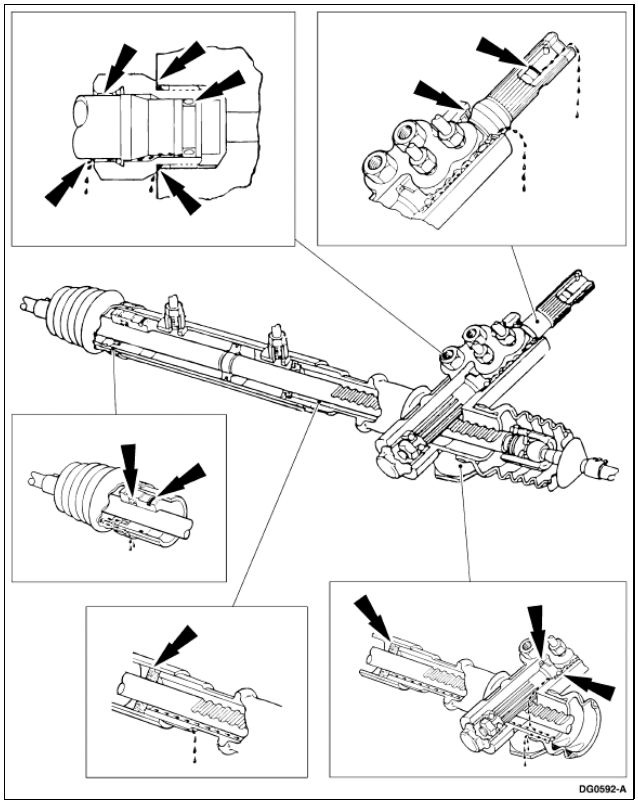
2. Inspect Tires
   - Check the tire pressure. For additional information, refer to the Vehicle Certification (VC) label.
   - Verify that all tires are sized to specification. For additional information, refer to Section 204-04 .
   - Check the tires for damage or uneven wear. For additional information, refer to Section 204-04 .

3. Belt and Tensioner Check
   - Refer to Section 303-05 for diagnosis and testing of the accessory drive system.

4. Fluid Level Check
   - Verify that the power steering fluid level is within the appropriate hot or cold range on the dipstick. Add MERCON® Multi-Purpose (ATF) Transmission Fluid XT-02-QDX or MERCON® equivalent.

5. Air Bleeding
   - Verify that there is no air in the power steering system. Run the engine (6007) until it reaches normal operating temperature. Turn the steering wheel to the left and right several times without hitting the stops. If any air bubbles are present, refer to Purging in this section.

External Leak Check Typical Power Rack-and-Pinion Steering Gear



6. External Leak Check
   - With the ignition switch at OFF, wipe off the power steering pump, power steering pressure hose (3A719), power steering return hose (3A713), power steering fluid cooler and hose assembly and steering gear (3504).
   - With the engine running, turn the steering wheel from stop-to-stop several times. Do not hold steering wheel at stops. Check for leaks. Repair as necessary if leaks are observed.

7. Turning Effort Check
   - Refer to Turning Effort Test under Component Tests in this section.

8. Visually inspect for obvious signs of mechanical damage. For additional information, refer to the following chart.

   Visual Inspection Chart

Mechanical	Electrical
• Loose tie-rod ends • Loose suspension components • Loose steering column shaft universal joints • Loose column intermediate shaft bolts • Steering gear • Binding or misaligned steering column • Power steering pump • Bent or pinched power steering hoses	• Wiring • Connectors

9. If an obvious cause for an observed or reported malfunction is found, correct the cause (if possible) before proceeding to the next step.

10. If the concern remains after the inspection, connect the Scan Tool to the data link connector (DLC) located beneath the instrument panel, and select the vehicle to be tested from the Scan Tool menu. If the Scan Tool does not communicate with the vehicle:
    - Check that the program card is correctly installed.
    - Check the connections to the vehicle.
    - Check the ignition switch position.

11. If the Scan Tool still does not communicate with the vehicle, refer to the tester manual.

12. Carry out the DATA LINK DIAGNOSTIC TEST. If Scan Tool responds with:
    - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
    - NO RESP/NOT EQUIP for FEM, refer to Section 418-00 .
    - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out the self-test diagnostics for the FEM.

13. If the DTCs retrieved are related to the concern, go to Diagnostic Trouble Code (DTC) Index to continue diagnostics.

14. If no DTCs related to the concern are retrieved, GO to Symptom Chart to continue diagnostics.

15. If the fault is not visually evident, determine the symptom. GO to Symptom Chart .

Diagnostic Trouble Code (DTC) Index

FEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
C1924	VAPS Solenoid Actuator Output Circuit Short to Ground	FEM	Go To Pinpoint Test A .
C1925	VAPS Solenoid Actuator Return Circuit Failure	FEM	Go To Pinpoint Test B .
U1027	SCP (J1850) Invalid or Missing Data for Engine rpm	PCM	GO to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	GO to Section 418-01 .
U1059	SCP (J1850) Invalid or Missing Data for Transmission / Transaxle / PRNDL	PCM	GO to Section 418-01 .
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	GO to Section 418-01 .
U1222	SCP (J1850) Invalid or Missing Data for Interior Lamps	ICM	GO to Section 418-01 .
U1227	SCP (J1850) Invalid or Missing Data for Body Status Request	ICM	GO to Section 418-01 .

Steering System Symptom Definitions

Drift/Pull

Pull is a tugging sensation, felt by the hands on the steering wheel, that must be overcome to keep the vehicle going straight.

Drift describes what a vehicle with this condition does with hands off the steering wheel.

- A vehicle-related drift/pull, on a flat road, can cause a consistent deviation from the straight-ahead path and require constant steering input in the opposite direction to counteract the effect.
- Drift/pull can be induced by conditions external to the vehicle (i.e., wind, road camber).

Excessive Steering Wheel Play

Excessive steering wheel play is a condition in which there is too much steering wheel movement before the wheels move. A small amount of steering wheel free play is considered normal.

Feedback

Feedback is a roughness felt in the steering wheel when the vehicle is driven over rough pavement.

Hard Steering or Lack of Assist

Hard steering or lack of assist is experienced when the steering wheel effort exceeds specifications. Hard steering can remain constant through the full turn or occur near the end of a turn. It is important to know the difference between hard steering/lack of assist and binding.

Hard steering or lack of assist can result from either hydraulic or mechanical conditions. It is extremely important to know if this concern occurs during driving, during very heavy or static parking maneuvers.

Nibble

Sometimes confused with shimmy, nibble is a condition resulting from tire interaction with various road surfaces and observed by the driver as small rotational oscillations of the steering wheel.

Poor Returnability/Sticky Steering

Poor returnability and sticky steering is used to describe the poor return of the steering wheel to center after a turn or the steering correction is completed.

Shimmy

Shimmy, as observed by the driver, is large, consistent, rotational oscillations of the steering wheel resulting from large, side-to-side (lateral) tire/wheel movements.

Shimmy is usually experienced near 64 km/h (40 mph), and can begin or be amplified when the tire contacts pot holes or irregularities in the road surface.

Wander

Wander is the tendency of the vehicle to require frequent, random left and right steering wheel corrections to maintain a straight path down a level road.

Symptom Chart

Symptom Chart
Pinpoint Tests

PINPOINT TEST A: DTC C1924 VAPS SOLENOID ACTUATOR OUTPUT CIRCUIT SHORT TO GROUND

PINPOINT TEST B: DTC C1925 VAPS SOLENOID ACTUATOR RETURN CIRCUIT FAILURE

Component Tests

Steering Linkage

1. With the parking brake applied, carry out the following:
    1. **NOTE:** Excessive vertical or horizontal motion of the stud relative to the steering linkage ball sockets may indicate excessive wear.

       Have an assistant rotate the steering wheel back and forth 360 degrees and watch for relative motion of the studs in the steering linkage ball sockets.
    2. Watch for a loose steering gear attachment to the frame.
2. Another method is to raise the front tires off the ground, grasp the tire at the front and rear and watch for excessive play in the joints while trying to pivot the wheels by hand.
3. **NOTE:** Incorrect separation of the tapered stud from its seat will cause premature failure of the ball socket.

   Joints can be checked for excessive wear by measuring the torque it takes to turn the stud.

    1. Separate the tapered stud from its seat and thread the attaching nut back onto the stud.
    2. **NOTE:** Some joint turning torques will be as little as 0.2 Nm (2 lb-in) within the first 1,000 miles and will remain there for the life of the joint.

       Turn the stud with an inch-pound torque wrench and note the torque required to turn the stud.

Torque Required to Turn Stud in Socket	Nm	Lb-In
New joints	2.0-5.0	18-47
Used joints	0.2-3	2-26
Joints with excessive play	Less than 0.2	Less than 0.2

    3. **NOTE:** Only install a new ball joint if the stud torque is less than 0.2 Nm (2 lb-in) and the joint has any play when moved by hand.

       Install new ball joints as necessary; refer to Section 204-01 .

Pump Flow and Pressure Test

⚠ WARNING: Do not touch the flowmeter during the test procedure or severe burns and serious injury may occur.

1. ⚠ **CAUTION: Make sure that the connection point will not interfere with any of the engine accessory drive components or drive belts.**

   Install the Power Steering Analyzer at the high pressure port of the power steering pump. Make sure the power steering analyzer gate valve is fully open.

   - On some vehicles, the power steering pump high pressure port is inaccessible and the power steering analyzer should then be installed either at the steering gear or at a point in the high pressure line between the power steering pump and the steering gear.

2. Place a Dial Thermometer in the power steering pump reservoir.

3. Check the power steering fluid level. If necessary, add power steering fluid.
   - Use Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX or equivalent meeting Ford specification MERCON®.

4. Install the digital tachometer.

5. ⚠ **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

   Start the engine. Place the transmission in N (neutral). Set the parking brake. Raise the power steering fluid temperature to 74-80°C (165-175°F) by rotating the steering wheel fully to the left and right several times.

6. Set the engine speed to idle. Record the flow rate and pressure readings.
   - If the flow rate is below the idle flow rate specification, the power steering pump may require repair. Continue with the test procedure.
   - If the pressure reading is above the idle pressure specification, then check power steering hoses for kinks and restrictions.

7. Partially close the gate valve to obtain 5102 kPa (740 psi). Record the flow rate.
   - If the flow rate is less than the specified flow rate, replace the power steering pump.

8. ⚠ **CAUTION: Do not allow the gate valve to remain closed for more than five seconds.**

   Completely close and partially open the gate valve three times. Record the pressure relief valve actuation pressure reading.

   - If the pressure does not meet the relief pressure specification, install a new power steering pump.

9. Set the engine speed to 1,500 rpm. Record the flow rate.
   - If the flow rate varies more than 3.785 liters/minute (1 gallon/minute) from initial flow rate reading, install a new power steering pump.

10. ⚠ **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

    Set the engine speed at idle. Turn (or have an assistant turn) the steering wheel to the left and right stops. Record flow rate and pressure readings at the stops.

    - The pressure reading at both stops should be nearly the same as the maximum pump relief pressure.

- The flow rate should drop below 1.9 liters/minute (0.5 gallon/minute).
- If the pressure does not reach the maximum pump relief pressure or the flow rate does not drop below the specified value, excessive internal leakage is occurring. Repair or install a new steering gear as necessary; refer to Section 211-02 .

11. Turn (or have an assistant turn) the steering wheel slightly in both directions and release it quickly while watching the pressure gauge.
    - The pressure reading should move from the normal backpressure reading and snap back as the steering wheel is released.
    - If the pressure returns slowly or sticks, the rotary valve in the steering column is binding. Check the steering column and linkage before repairing the steering gear.

Turning Effort Test

NOTE: Make sure front wheels are correctly aligned and tire pressure is correct before checking turning effort.

1. Park vehicle on dry concrete and set parking brake.

2. Idle engine for two to three minutes. Turn steering wheel to the left and right several times to warm fluid to 43-49°C (110-120°F).

3. With engine running, attach a pull scale to rim of steering wheel. Measure pull required to turn one complete revolution in each direction. Refer to Specifications for Static Steering Wheel Turning Efforts for acceptable measurements.

Steering Gear Insulator

1. With the wheel normally loaded (on the ground), check the steering gear housing for excessive lateral movement.
    - If the steering gear housing moves more than 1.5 mm (0.05 in), the steering gear insulators may have deteriorated or the steering gear mounting nuts may have loosened. Tighten the steering gear mounting nuts.
    - If the steering gear housing movement is still excessive after tightening the gear mounting nuts, install new steering gear insulators.

Steering Gear Valve

NOTE: For vehicles with a steering pull.

1. With the vehicle in motion, place the transmission in N (neutral) and turn the engine OFF.
    - If the vehicle does not pull with the engine OFF, repair or install a new steering gear; refer to Section 211-02 .
    - If the vehicle pull direction does not change, check the front suspension components and wheel alignment; refer to Section 204-00 and Section 204-01 .

Tie-Rod Articulation Torque

1. **NOTE:** This check can be done with the steering gear on or off the vehicle.

Disconnect the tie-rod end from the front wheel spindle. For additional information, refer to Section 211-02 .

2. Move the tie-rod back and forth three times.

3. Hook the Spring Scale over the tie-rod end or the threaded portion of the tie-rod and measure the force required to move the front wheel spindle tie-rod. For additional information, refer to Tie-Rod Articulation Torque in General Specifications in this section.

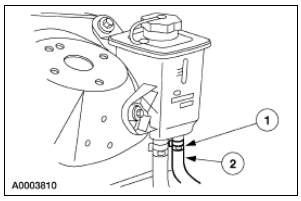
4. If the force required to move the front wheel spindle tie-rod does not meet the specifications, install a new tie-rod.

Power Steering System Flushing

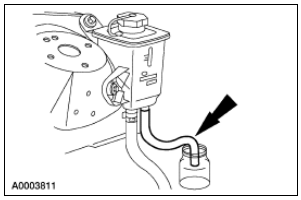
⚠ WARNING: Do not mix fluid types. Any mixture of an unapproved fluid could lead to seal deterioration and leaks. A leak could ultimately cause loss of fluid, which could result in a loss of power steering assist.

1. Remove the coil on plug (COP) Fuse 12 in the underhood auxiliary junction box (AJB) to disable the engine from starting.

2. Disconnect the power steering return hose.
    1. Compress and move the hose clamp.
    2. Disconnect the power steering return hose and plug the fitting to the reservoir.



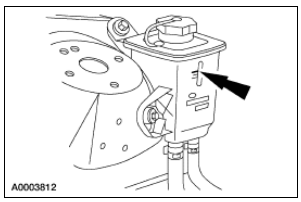
3. Attach an extension hose between the power steering reservoir port and an empty container.



4. **⚠ WARNING: Do not mix fluid types. Any mixture of an unapproved fluid could lead to seal deterioration and leaks. A leak could ultimately cause loss of fluid, which could result in a loss of power steering assist.**

   Fill the power steering fluid reservoir.

   - Use Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX or equivalent meeting Ford specification MERCON®.



5. Raise the front wheels off the ground. For additional information, refer to Section 100-02 .

6. **⚠ CAUTION: Do not operate the starter motor for more than 10 seconds at a time. Damage to the starter motor could result.**

   Turn the steering wheel from stop to stop while cranking the engine until the fluid exiting the extension hose is clean.

7. Lower the vehicle.

8. Disconnect the extension hose from the power steering return hose and attach the power steering return hose to the power steering fluid reservoir.

9. ⚠ **WARNING: Do not mix fluid types. Any mixture of an unapproved fluid could lead to seal deterioration and leaks. A leak could ultimately cause loss of fluid, which could result in a loss of power steering assist.**

   ⚠ **CAUTION: Do not overfill the power steering fluid reservoir.**

   Fill the power steering fluid reservoir.

   - Use Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX or equivalent meeting Ford specification MERCON®.

10. Install the COP fuse.

11. ⚠ **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds at a time. Damage to the power steering pump will occur.**

    Start the engine and turn the steering wheel from stop to stop.

12. **NOTE:** If power steering is noisy and accompanied by evidence of aerated fluid, it will be necessary to purge the power steering system. Refer to Power Steering System Purging .

    Check the power steering fluid level.

Power Steering System Purging

Special Tool(s)

 ST1178-A	Vacuum Tester or equivalent 014-R1054

⚠ CAUTION: If the air is not purged from the power steering system correctly, pump failure could result. This condition can occur on pre-delivery vehicles with evidence of aerated fluid or on vehicles that had steering component repairs.

1. **⚠ WARNING: Do not mix fluid types. Any mixture of an unapproved fluid could lead to seal deterioration and leaks. A leak could ultimately cause loss of fluid, which could result in a loss of power steering assist.**

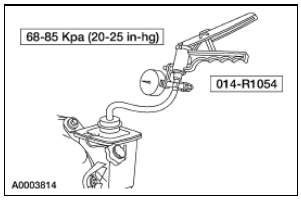
   ⚠ CAUTION: Do not overfill the power steering fluid reservoir.

   NOTE: A whine heard from the power steering pump may be caused by air in the system. The power steering purge procedure must be carried out prior to any component repair for which power steering noise complaints are accompanied by evidence of aerated fluid and after installation of any new power steering system components (gear, hose, etc.).

   Remove the fluid reservoir cap and check the fluid.

   - Using the special tool, tightly insert the stopper into the fluid reservoir.
   - Start the vehicle.

2. Apply maximum vacuum for a minimum of three minutes at idle. Maintain maximum vacuum with the source.

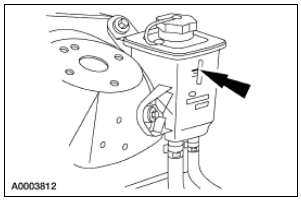


3. Remove the special tool.

4. **⚠ WARNING: Do not mix fluid types. Any mixture of an unapproved fluid could lead to seal deterioration and leaks. A leak could ultimately cause loss of fluid, which could result in a loss of power steering assist.**

   Add fluid to the appropriate level.

   - Use Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX or equivalent meeting Ford specification MERCON®.



5. Using the special tool, apply and maintain maximum vacuum.

6. ⚠ **CAUTION: Do not hold the steering wheel against the stops for more than three to five seconds. Damage to the power steering pump will occur.**

   Cycle the steering wheel from stop to stop every 30 seconds for approximately five minutes.

7. Remove the special tool and install the fluid reservoir cap.

8. ⚠ **WARNING: Do not mix fluid types. Any mixture of an unapproved fluid could lead to seal deterioration and leaks. A leak could ultimately cause loss of fluid, which could result in a loss of power steering assist.**

   Check the fluid level and for leaks at all connections. If the power steering still shows signs of aeration, repeat this procedure.

Power Steering System Filling

1. ⚠ **WARNING: Do not mix fluid types. Any mixture of an unapproved fluid could lead to seal deterioration and leaks. A leak could ultimately cause loss of fluid, which could result in a loss of power steering assist.**

   Fill the power steering reservoir to the appropriate level.

   - Use Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX or equivalent meeting Ford specification MERCON®.

2. Remove the coil on plug (COP) Fuse 12 in the underhood auxiliary junction box (AJB) to disable the engine from starting.

3. Raise the front wheels off the floor. For additional information, refer to Section 100-02 .

4. ⚠ **CAUTION: Do not operate the starter motor for more than 10 seconds at a time. Damage to the starter motor could result.**

   Turn the steering wheel from stop to stop while cranking the engine.

5. Lower the vehicle.

6. ⚠ **CAUTION: Do not overfill the power steering fluid reservoir.**

   Fill the power steering fluid reservoir to the appropriate level.

   - Use Motorcraft MERCON® Multi-Purpose (ATF) Transmission Fluid XT-2-QDX or equivalent meeting Ford specification MERCON®.

7. Install the COP fuse.

8. **NOTE:** If the power steering is noisy and accompanied by evidence of aerated fluid, it will be necessary to purge the power steering system. For additional information, refer to Power Steering System Purging .

   Clear the diagnostic trouble codes (DTCs). For additional information, refer to Section 2 in the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

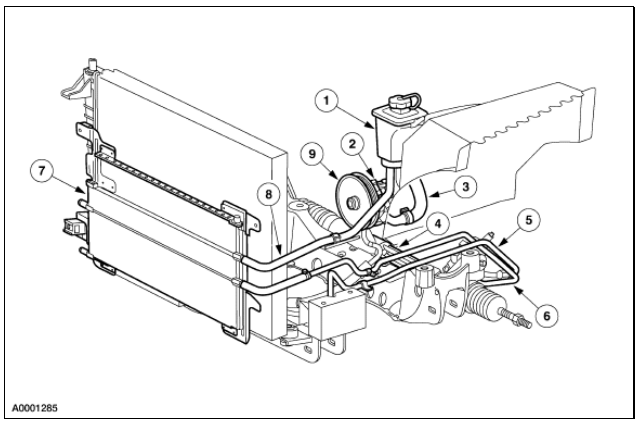
   - Run the vehicle and check the system for leaks.

Torque Specifications

Description	Nm	lb-ft	lb-in
Power steering pump bolts	25	18	
Power steering reservoir top bolt	6		53
Power steering reservoir side bolt	12	9	
Power steering pressure hose-to-pump fitting	31	23	
Power steering pressure hose-to-gear fitting	31	23	
Power steering return hose-to-gear fitting	31	23	
Power steering pressure hose bracket-to-frame bolt	10		89
Power steering hose bracket-to-steering gear housing bolt	10		89
Steering gear nuts	103	76	
Power steering pressure hose bracket-to-pump bolt	10		89
Cooler-to-radiator bolts	10		89
Intermediate shaft bolt	25	18	
Intermediate shaft-to-gear pinch bolt	35	26	
Steering column shaft-to-intermediate shaft pinch bolt	35	26	
Steering column lock nuts	40	30	
A/C compressor bolts	25	18	
Radiator tube-to-engine bolts	10		89
Wheel nuts	135	100	
Tie-rod-to-rack	120	88	
Tie-rod end-to-knuckle nut	100	74	
Control valve actuator	30	22	
Steering column opening reinforcement bolts	20	15	
I-brace bolts (front)	55	41	
I-brace bolts (rear)	30	22	

Power Steering

System View



Item	Part Number	Description
1	3E764	Power steering fluid reservoir
2	3A674	Power steering pump
3	3691	Power steering reservoir-to-pump hose
4	3504	Power steering gear
5	3A719	Power steering pressure hose
6	3A713	Power steering return hose
7	3D746	Power steering fluid cooler
8		Power steering cooler-to-reservoir hose
9	3A733	Power steering pump pulley

The power steering system consists of the following components:

- power steering pump (3A674)
- power steering fluid reservoir (3E764)
- power rack and pinion gear (3504)
- power steering fluid cooler (3D746) incorporated into an automatic transmission fluid cooler and hydraulic cooling fan fluid cooler
- hoses connecting the various components

Power Steering

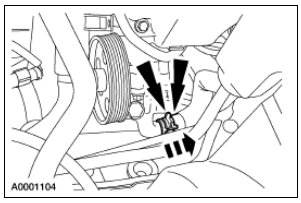
Refer to Section 211-00 .

Power Steering Fluid Reservoir

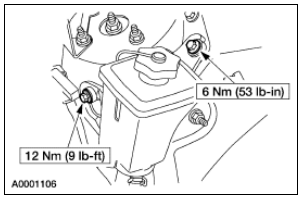
Removal

1. Remove the air cleaner. For additional information, refer to Section 303-12 .

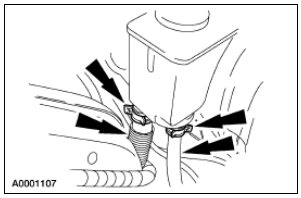
2. Unclamp and disconnect the power steering reservoir-to-pump hose (3691) and drain the reservoir into a suitable container. Plug the pump inlet fitting.



3. Loosen the bolts and detach the reservoir from the insulators.



4. Unclamp and disconnect the hoses.



5. Remove the reservoir.

6. To install, reverse the removal procedure.

7. Fill, purge and leak check the system. For additional information, refer to Section 211-00 .

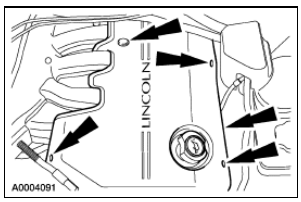
Power Steering Pump 3.9L

Special Tool(s)

 ST1444-A	Teflon® Seal Replacer Set 211-D027 (D90P-3517-A) or Equivalent

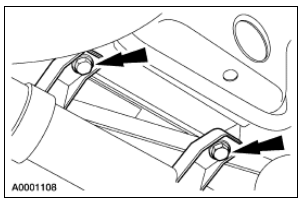
Removal

1. Remove four pushpins and the engine cover.



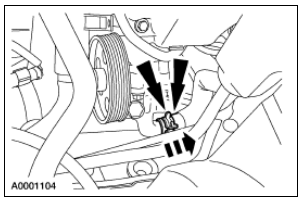
2. Remove the air cleaner and the air cleaner outlet tube. For additional information, refer to Section 303-12 .

3. Remove the bolts.

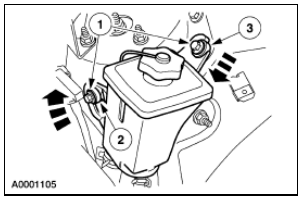


4. Remove the accessory drive belt. For additional information, refer to Section 303-05 .

5. Unclamp and disconnect the power steering reservoir-to-pump hose (3691) and drain the reservoir (3E764) into a suitable container.



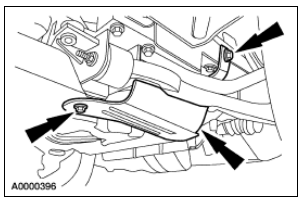
6. Position the power steering reservoir out of the way.
    1. Loosen the bolts.
    2. Rotate the reservoir from the insulator.
    3. Pull the reservoir down from the insulator and position the reservoir out of the way.



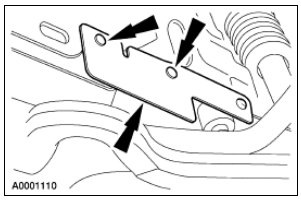
7. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .

8. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

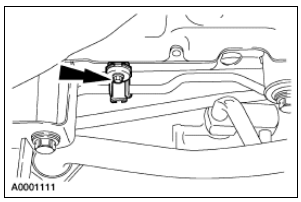
9. Remove two bolts, one pushpin and the shield.



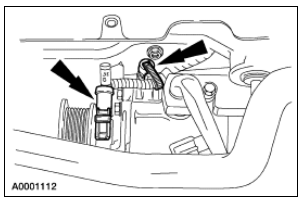
10. Remove two pushpins and the shield.



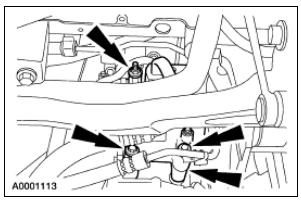
11. Remove the bolt.



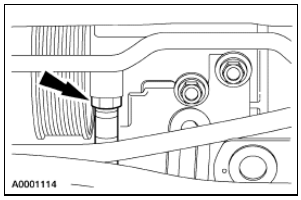
12. Disconnect the electrical connector and the wire retainer.



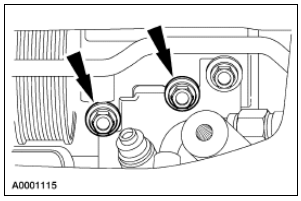
13. Remove four bolts and position the A/C compressor out of the way.



14. Disconnect the power steering pressure hose (3A714).

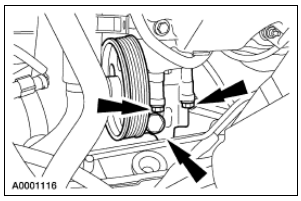


15. Remove the bolts.



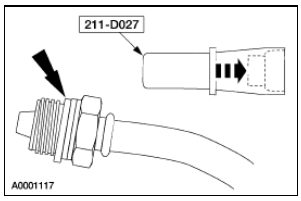
16. Lower the vehicle.

17. Remove the bolts and the pump (3A674).



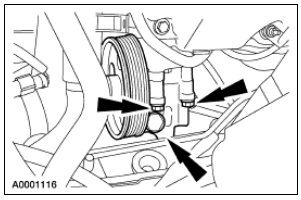
Installation

1. Using the appropriate special tool, install a new O-ring on the power steering pressure hose fitting.



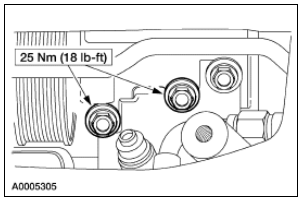
2. **NOTE:** Do not tighten the upper bolts until the lower bolts are installed.

   Position the pump and install the bolts.

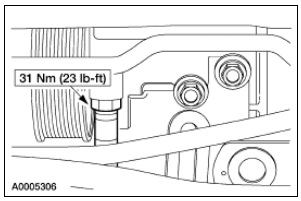


3. Raise the vehicle.

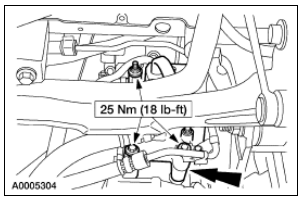
4. Install the bolts.



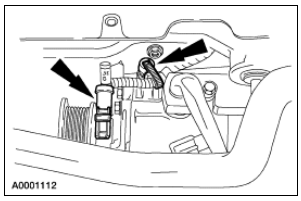
5. Connect the power steering pressure hose.



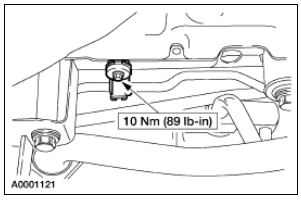
6. Position the A/C compressor and install four bolts.



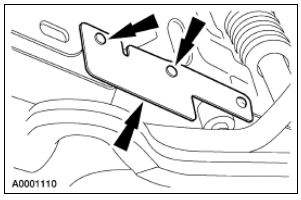
7. Connect the wire retainer and the electrical connector.



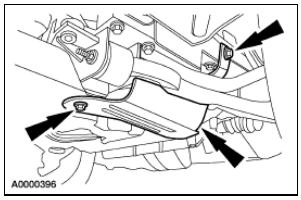
8. Install the bolt.



9. Install the shield and two pushpins.



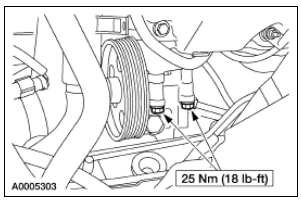
10. Install the shield, one pushpin and two bolts.



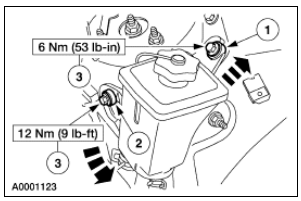
11. Install the wheel and tire assembly. For additional information, refer to Section 204-04 .

12. Lower the vehicle.

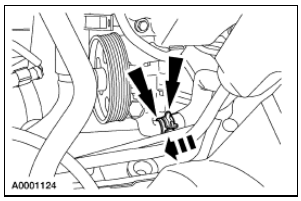
13. Tighten the bolts.



14. Connect the reservoir.
    1. Push the reservoir up on the insulator.
    2. Rotate the reservoir on the insulator.
    3. Tighten the bolts.

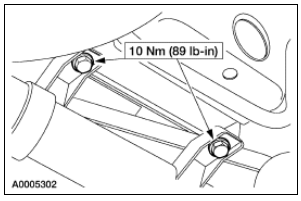


15. Connect and clamp the power steering reservoir-to-pump hose.



16. Install the accessory drive belt. For additional information, refer to Section 303-05 .

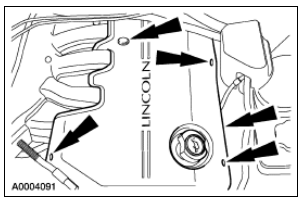
17. Install the bolts.



18. Install the air cleaner outlet tube and the air cleaner. For additional information, refer to Section 303-12 .

19. **NOTE:** Inspect the pushpins for cracks or other damage. Install new pushpins if necessary.

Install the engine cover and four pushpins.



20. Fill and leak check the system. For additional information, refer to Section 211-00 .

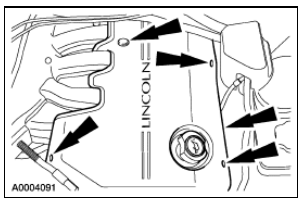
Power Steering Pump 3.0L

Special Tool(s)

 ST1444-A	Teflon® Seal Replacer Set 211-D027 (D90P-3517-A) or Equivalent

Removal

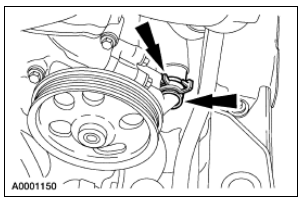
1. Remove four pushpins and the engine cover.



2. Remove the air cleaner and the air cleaner outlet tube. For additional information, refer to Section 303-12 .

3. Remove the accessory drive belt. For additional information, refer to Section 303-05 .

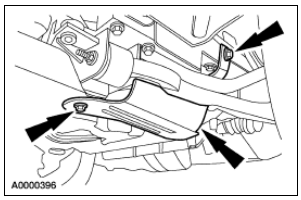
4. Unclamp and disconnect the power steering reservoir-to-pump hose (36911) and drain the reservoir into a suitable container.



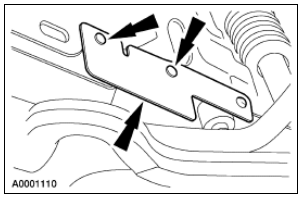
5. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .

6. Remove the wheel and tire assembly. For additional information, refer to Section 204-04 .

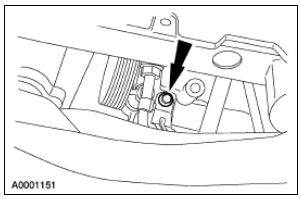
7. Remove two bolts, one pushpin and the shield.



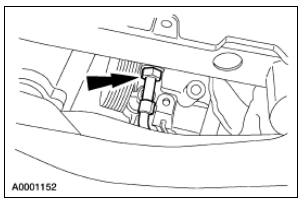
8. Remove two pushpins and the shield.



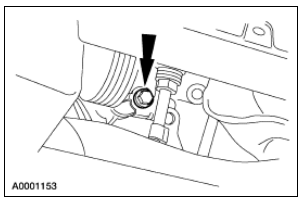
9. Remove the bolt.



10. Disconnect the power steering pressure hose (3A714).

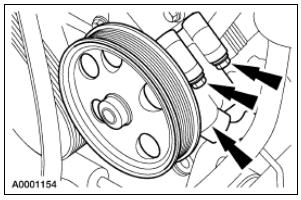


11. Remove the bolt.



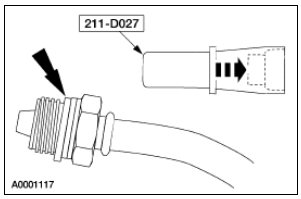
12. Lower the vehicle.

13. Remove the bolts and the pump (3A674).



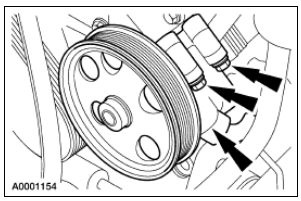
Installation

1. Install a new O-ring on the power steering pressure hose fitting.



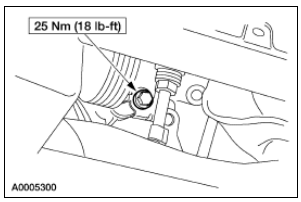
2. **NOTE:** Do not tighten the upper bolts until the lower bolts are installed.

Install the pump and the bolts.

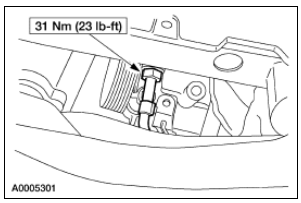


3. Raise the vehicle.

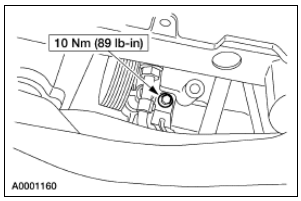
4. Install the bolt.



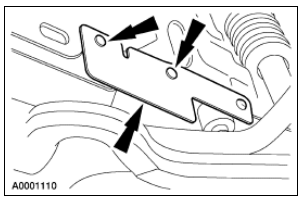
5. Connect the power steering pressure hose.



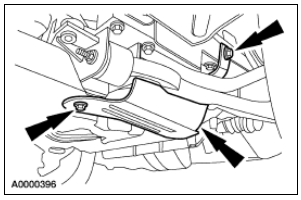
6. Install the bolt.



7. Install the shield and two pushpins.



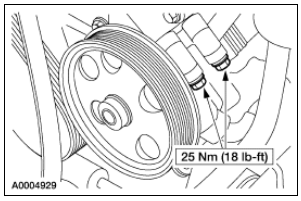
8. Install the shield, one pushpin and two bolts.



9. Install the wheel and tire assembly. For additional information, refer to Section 204-04 .

10. Lower the vehicle.

11. Tighten the bolts.

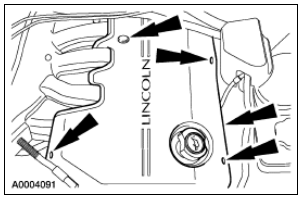


12. Install the accessory drive belt. For additional information, refer to Section 303-05 .

13. Install the air cleaner outlet tube and the air cleaner cover. For additional information, refer to Section 303-12 .

14. **NOTE:** Inspect the pushpins for cracks or other damage. Install new pushpins if necessary.

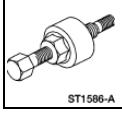
    Install the engine cover and four pushpins.



15. Fill and leak check the system. For additional information, refer to Section 211-00 .

Power Steering Pump Pulley 3.9L

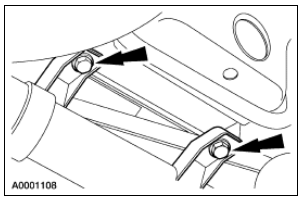
Special Tool(s)

	Remover, Power Steering Pump Pulley 211-016 (T69L-10300-B)
 ST1586-A	Installer, Power Steering Pump Pulley 211-185 (T91P-3A733-A)

Removal

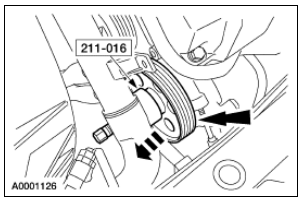
1. Remove the air cleaner and the air cleaner outlet tube. For additional information, refer to Section 303-12 .

2. Remove the bolts.


A0001108

3. Remove the accessory drive belt. For additional information, refer to Section 303-05 .

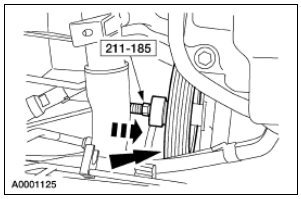
4. Using the special tool, remove the pulley (3A733).



A0001126

Installation

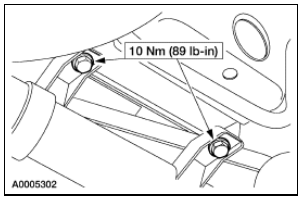
1. Using the special tool, install the pulley.



A0001125

2. Install the accessory drive belt. For additional information, refer to Section 303-05 .

3. Install the bolts.



4. Install the air cleaner outlet tube and the air cleaner. For additional information, refer to Section 303-12 .

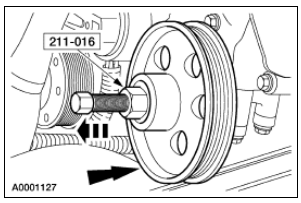
Power Steering Pump Pulley 3.0L

Special Tool(s)

	Pump Pulley Remover 211-016 (T69L-10300-B)
 ST1586-A	Pump Pulley Replacer 211-185 (T91P-3A733-A)

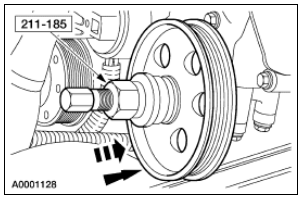
Removal

1. Remove the air cleaner cover and the air cleaner outlet tube. For additional information, refer to Section 303-12 .
2. Remove the accessory drive belt. For additional information, refer to Section 303-05 .
3. Using the special tool, remove the pulley (3A733).



Installation

1. Using the special tool, install the pulley.



2. Install the accessory drive belt. For additional information, refer to Section 303-05 .
3. Install the air cleaner outlet tube and the air cleaner cover. For additional information, refer to Section 303-12 .

Power Steering Pump to Steering Gear Pressure Line

Special Tool(s)

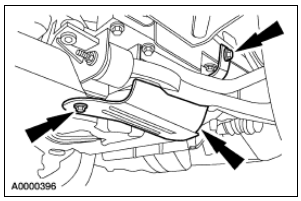
 ST1444-A	Teflon® Seal Replacer Set 211-D027 (D90P-3517-A) or equivalent

Removal and Installation

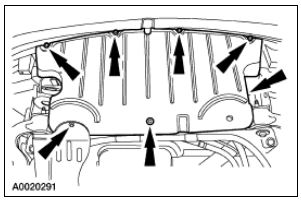
All vehicles

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

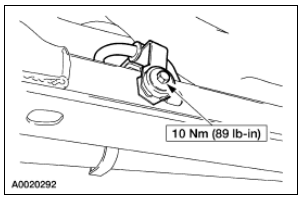
2. Remove the screw, pushpin and the air deflector.



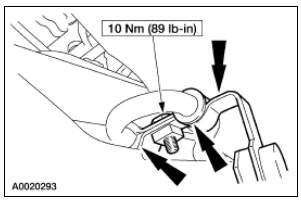
3. Remove the screws and the air deflector.



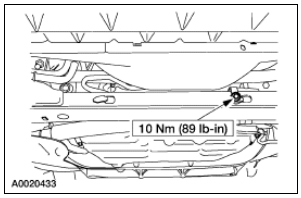
4. Remove the bolt.



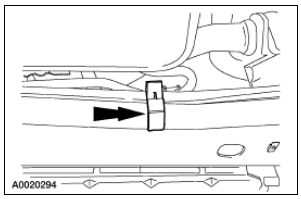
5. Remove the bolt, bracket and bushings.



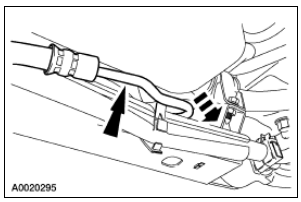
6. Remove the bolt.



7. Unclip the retainer.

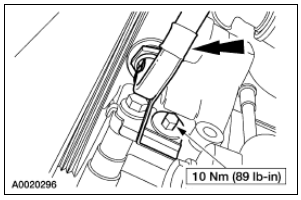


8. Pull the hose rearward between the oil pan and the radiator support crossmember.

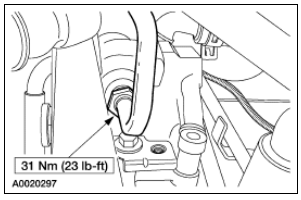


3.0L engine

9. Remove the bolt and the bracket.

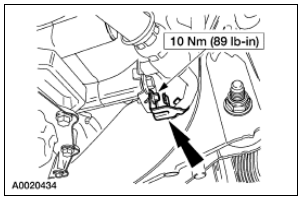


10. Disconnect the hose (3A719) at the pump.

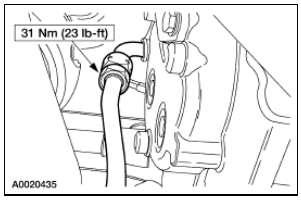


3.9L engine

11. Remove the bolt and the bracket.

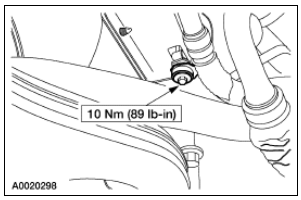


12. Disconnect the hose (3A719) at the pump.
    - Drain the fluid into a suitable container.

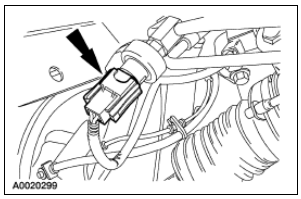


All vehicles

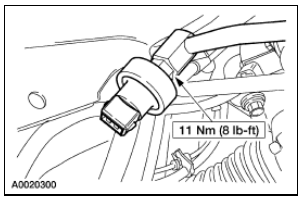
13. Remove the bolt.



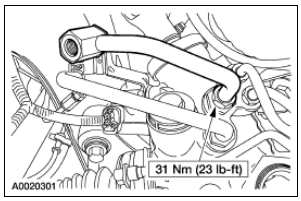
14. Disconnect the wiring at the pressure switch (3N824).



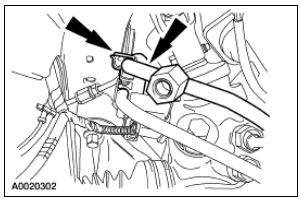
15. Remove the pressure switch.
    - Drain the fluid into a suitable container.



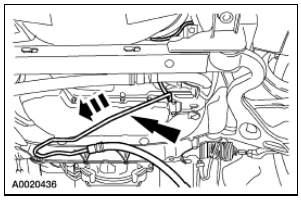
16. Disconnect the hose at the steering gear.



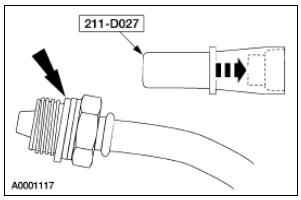
17. Unclip the retainer and detach the hose.



18. Remove the hose.



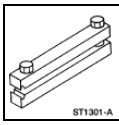
19. To install, reverse the removal procedure.
    - Install a new seal using the special tool.



20. Fill and leak check the system. For additional information, refer to Section 211-00 .

Power Steering Fluid Cooler

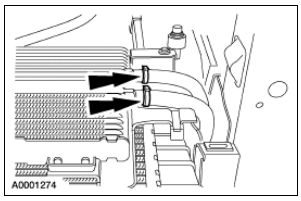
Special Tool(s)

	Installer, Constant Velocity Boot Clamp 205-343 (T95P-3514-A)

Removal

1. Remove the A/C condenser core. For additional information, refer to Section 412-03 .

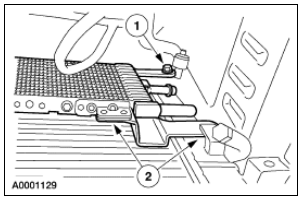
2. Remove and discard the six clamps.



3. **NOTE:** Position a drain pan under the vehicle to catch any fluid that may spill.

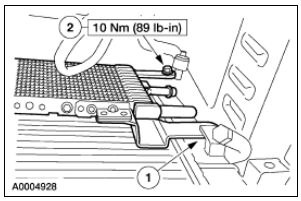
   Disconnect the hoses. Plug the hoses and the cooler (3D746).

4. Remove the cooler.
   1. Remove two bolts.
   2. Lift the cooler from the retainers and remove the cooler.



Installation

1. Install the cooler.
   1. Position the cooler on the retainers.
   2. Install two bolts.

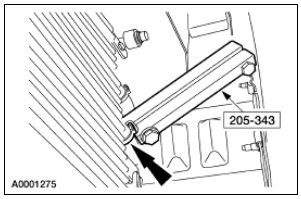


2. Position new clamps on the hoses.

3. **NOTE:** The fluid cooler ports and the hoses are color coded to ensure correct installation.

Unplug the hoses and the cooler. Connect the hoses.

4. Using the special tool, tighten the clamps.



5. Install the A/C condenser. For additional information, refer to Section 412-03 .

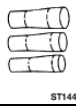
6. Fill, purge and leak check the system. For additional information, refer to Section 211-00 .

7. Check and fill the transmission. For additional information, refer to Section 307-01 .

8. Fill the cooling fan reservoir. For additional information, refer to Section 303-03 .

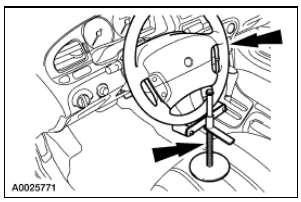
Steering Gear

Special Tool(s)

 ST1444-A	Installer Set, Teflon® Seal 211-D027 (D90P-3517-A) or equivalent

Removal and Installation

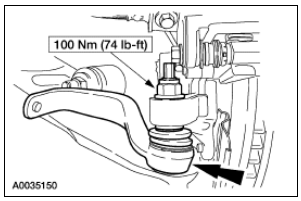
1. Hold the steering wheel in the straight-ahead position using a suitable holding device.



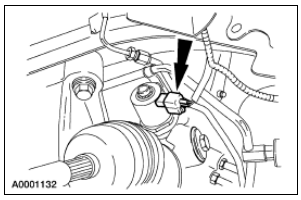
2. Remove the wheel and tire assemblies. For additional information, refer to Section 204-04 .

3. **NOTE:** To remove the nuts, first loosen the nut, and then use the hex holding feature to prevent the tie-rod end ball joint from turning.

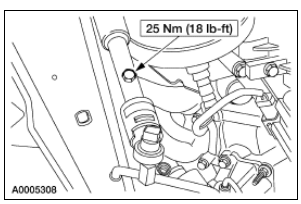
   Remove the nuts and disconnect the tie-rod ends (3A130). Discard the nuts.



4. Disconnect the electrical connector.

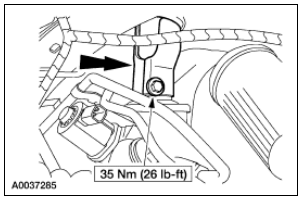


5. Loosen the bolt.

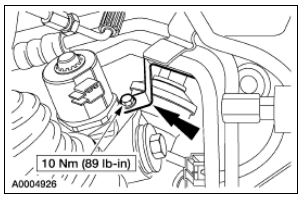


6. ⚠ **CAUTION: Do not allow the steering wheel to rotate while the steering column intermediate shaft is disconnected or damage to the clockspring can result. If there is evidence that the wheel has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

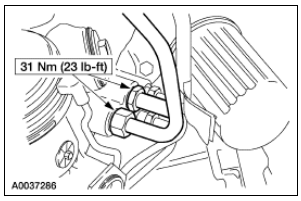
   Remove the pinch bolt and disconnect the intermediate shaft (3A525).



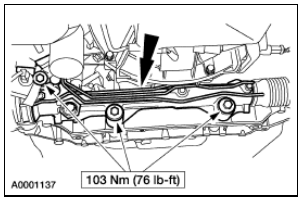
7. Remove the bolt and disconnect the power steering hose bracket.



8. Disconnect the power steering hoses. Plug the hose ends and the gear.

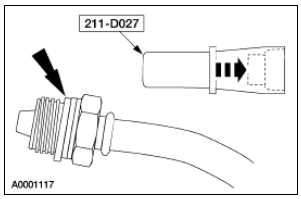


9. Remove the nuts, bolts and the power steering gear (3504). Discard the nuts.



10. To install, reverse the removal procedure.

11. Using the appropriate special tool, install new O-rings on the power steering pressure and return hose fittings.



12. Fill, purge and leak check the system. For additional information, refer to Section 211-00 .

13. Check wheel alignment. Adjust as necessary. For additional information, refer to Section 204-00 .

Power Steering Control Valve Actuator

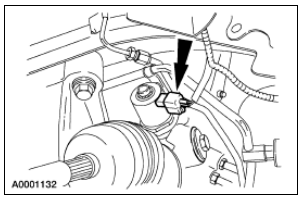
Special Tool(s)

 ST1444-A	Installer Set, Teflon® Seal 211-D027 (D90P-3517-A) or equivalent

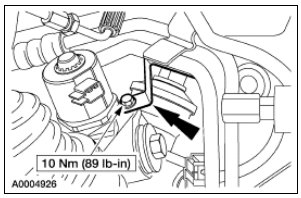
Removal and Installation

1. Raise the vehicle on a hoist. For additional information, refer to Section 211-00 .

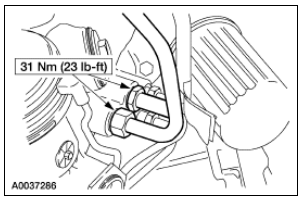
2. Disconnect the electrical connector.



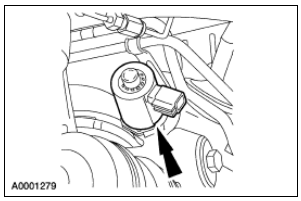
3. Remove the bolt and disconnect the power steering hose bracket.



4. Disconnect the power steering hoses. Plug the hose ends and the gear.

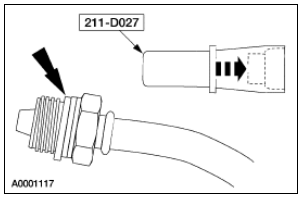


5. Remove the control valve actuator.



6. To install, reverse the removal procedure.

7. Using the appropriate special tool, install new O-rings on the power steering hose fittings.

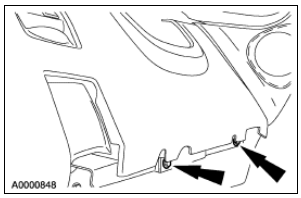

211-D027
A0001117

Steering Wheel Rotation Sensor

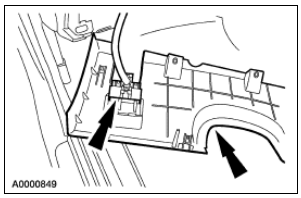
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

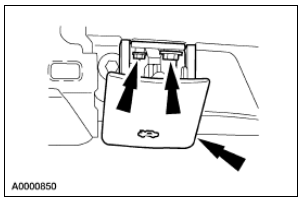
2. Remove the screws and pull the lower steering column opening finish panel out far enough to access the electrical connectors.



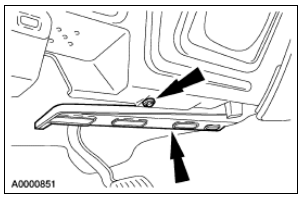
3. Disconnect the electrical connectors and remove the finish panel.



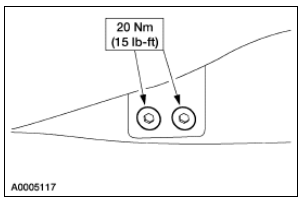
4. Remove the screws and disconnect the hood release assembly.



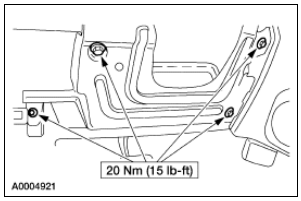
5. Remove the screw and the heater duct.



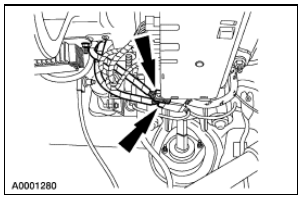
6. Pull the carpet away from the console tunnel and loosen the bolts.



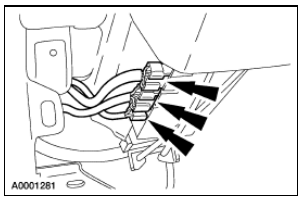
7. Remove four screws and the steering column opening reinforcement.



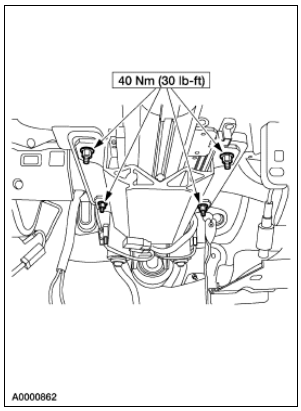
8. Disconnect the steering wheel rotation sensor and the electric tilt/telescoping motor electrical connectors.



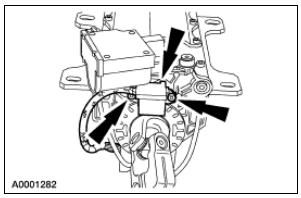
9. Disconnect the electrical connectors.



10. While supporting the steering column, remove the lock nuts and the steering column.
    - Discard the nuts.



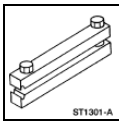
11. Remove the screws. Detach the electrical connector from the steering column and remove the sensor.



12. To install, reverse the removal procedure.

Steering Gear

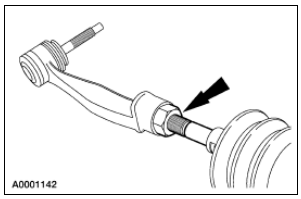
Special Tool(s)

 ST1301-A	Installer, Constant Velocity Boot Clamp 205-343 (T95P-3514-A)

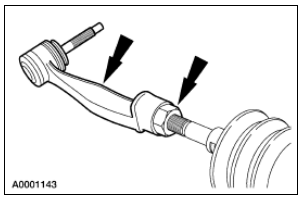
Disassembly

1. Position the power steering gear (3504) in a vice with protective caps.

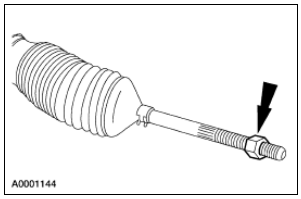
2. Mark the jam nuts and the tie-rods for installation reference.


A0001142

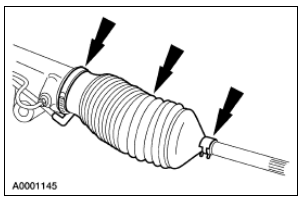
3. Loosen the jam nuts and remove the tie-rod ends (3A130).


A0001143

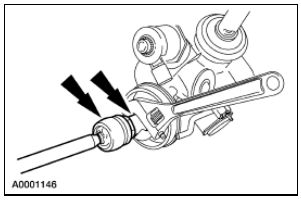
4. Remove the jam nuts.


A0001144

5. Remove the boot clamps and the boots.

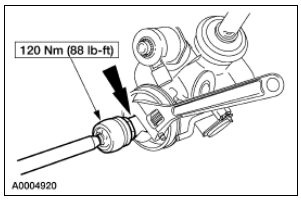

A0001145

6. While holding the rack, remove the tie-rods.

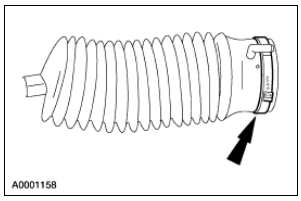


Assembly

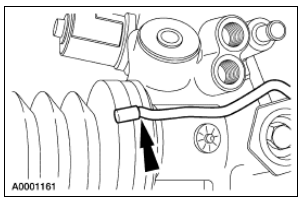
1. While holding the rack, install the tie-rods.



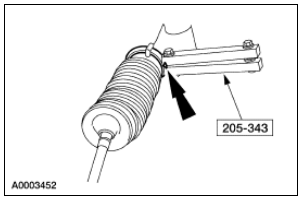
2. Position new inner clamps on the boots.



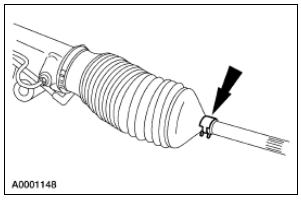
3. Position the boots on the gear, making sure the air tube is correctly installed in the boots and aligned between the locating marks on the gear housing.



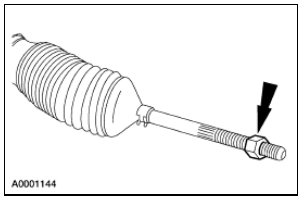
4. Using the special tool, tighten the clamps.



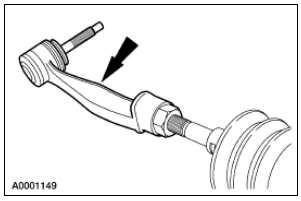
5. Install the clamp.



6. Install the jam nuts to the marks made during installation.



7. Install the tie-rod ends.



Torque Specifications

Description	Nm	lb-ft	lb-in
Steering column mounting nuts	17	13	
Steering column release motor assembly mounting screws	3		27
Steering column-to-intermediate shaft pinch bolt	30	22	
Intermediate shaft-to-gear pinch bolt	35	26	
Steering sensor screws	3		27
Steering wheel bolt	38	38	

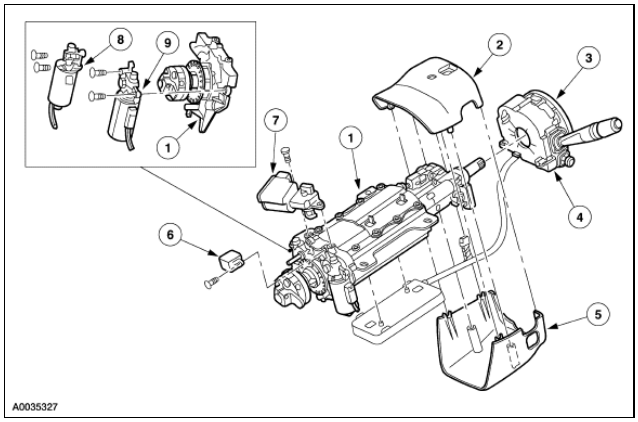
Steering Column

NOTE: All fasteners are important in that they can affect the performance of vital parts and systems, and their failure can result in major repair expenses. New fasteners of the same part number must be installed if the installation of new fasteners becomes necessary. Do not install a part of lesser quality or substitute design. Torque values must be used as specified during assembly to make sure these parts function correctly.

The vehicle is equipped with a power tilt/telescopic steering column that allows the steering wheel angle and length to be adjusted to suit the driver.

Power Tilt/Telescopic Steering Column

Exploded View Power Tilt/Telescopic Steering Column



Item	Part Number	Description
1	3C529	Steering column assembly
2	3530	Steering column upper shroud
3	14A664	Clockspring
4	13K359	Multi-function switch
5	3533	Steering column lower shroud
6	3F818	Steering sensor
7	3K772	Steering wheel lock actuator (manual transmission only)
8	3D538	Steering column release motor assembly (tilt)
9	3D538	Steering column release motor assembly (telescope)

The power tilt/telescopic steering column is of modular construction that features easy to service electrical switches.

The power tilt/telescopic steering columns are equipped with an electric tilt and telescopic mechanisms that allow the steering wheel angle and length to be adjusted to suit the driver. Vehicles with the memory package, the steering wheel position is stored in memory in the same way as the driver seat position and retrieved as a personality feature. The steering column is controlled by the instrument cluster module.

Before carrying out work on or around any supplemental air bag system component, observe all supplemental air bag system conditions and warnings to avoid unnecessary air bag deployment and possible injury. Refer to Section 501-20B for supplemental air bag system.

Ignition Switch

The ignition lock cylinder and switch are two components. When the lock cylinder ignition key is turned to different positions, it is aligning electrical contacts in the ignition switch. Electrical contacts are made in the ACC (Accessory), RUN and START positions. In the OFF position the switch is open and the key can be removed.

The ignition switch and lock cylinder assembly is mounted to the right of the steering column in the instrument panel. An opening in the instrument panel provides key access to the lock cylinder.

Steering Column

Refer to Section 211-00 .

Steering Column Tilt/Telescopic Motors

Refer to Wiring Diagrams Cell 128 for schematic and connector information.

Special Tool(s)

 ST1137-A	77 III Automotive Meter 105-R0056 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent scan tool

Inspection and Verification

1. Verify the customer's concern by operating the steering column switch to duplicate the condition.
2. Inspect to determine if one of the following apply:

   Visual Inspection Chart

Mechanical	Electrical
• Binding steering column	• Damaged fuse central power distribution box fuse 19 (15A) • Damaged multi-function switch • Circuitry open/shorted • Loose/corroded electrical connectors

3. If inspection reveals obvious concern(s) that can be readily identified, repair as required.
4. If the concern remains after the inspection, connect scan tool to the data link connector (DLC) located beneath the instrument panel to carry out DATA LINK DIAGNOSTIC TEST. Refer to Section 418-00 . If the scan tool responds with NO RESPONSE/NOT EQUIPPED for instrument cluster module (ICM), refer to Section 413-01 . If the DATA LINK DIAGNOSTIC TEST is passed for the ICM, retrieve continuous diagnostic trouble codes (DTCs) and execute Self Test Diagnostics for the ICM. Refer to Section 418-00 .
5. If the self test is passed and no diagnostic trouble codes (DTCs) are retrieved, GO to Symptom Chart to continue diagnostics.
6. If diagnostic trouble codes (DTCs) are retrieved, go to the Instrument Cluster Module (ICM) Diagnostic Trouble Code (DTC) Index to continue diagnostics.
7. If the instrument cluster module (ICM) cannot be accessed by the scan tool, refer to Section 413-01 .

Instrument Cluster Module (ICM) Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B2328	Steering Column Reach Feedback Potentiometer Circuit Failure	ICM	Go To Pinpoint Test A .
B2332	Steering Column Tilt Feedback Potentiometer Circuit Failure	ICM	Go To Pinpoint Test B .
B2328 and B2332	B2328 and B2332 Steering Column Feedback Potentiometers Circuit Failure	ICM	Go To Pinpoint Test D .
B2351	Steering Column Switch Signal Circuit Failure	ICM	Go To Pinpoint Test C .

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: DTC B2328: STEERING COLUMN REACH FEEDBACK POTENTIOMETER CIRCUIT FAILURE

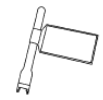
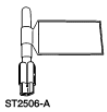
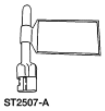
PINPOINT TEST B: DTC B2332: STEERING COLUMN TILT FEEDBACK POTENTIOMETER CIRCUIT FAILURE

PINPOINT TEST C: DTC B2351: STEERING COLUMN SWITCH SIGNAL CIRCUIT FAILURE

PINPOINT TEST D: THE TILT AND TELESCOPE ADJUSTMENT ARE INOPERATIVE

Supplemental Restraint System (SRS) Deactivation and Reactivation

Special Tool(s)

 ST2502-A	Diagnostic Tool, Restraint System (1 Req'd) 418-F395
 ST2506-A	Diagnostic Tool, Restraint System (3 Req'd) 418-F088 (105-R0012)
 ST2507-A	Diagnostic Tool, Restraint System (2 Req'd) 418-133 (40-009)

Deactivation

⚠ WARNING: Always wear safety glasses when repairing an air bag supplemental restraint system (SRS) vehicle and when handling an air bag module. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Carry a live air bag module with the air bag and trim cover pointed away from your body. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: Do not set a live air bag module down with the trim cover face down. This will reduce the risk of injury in the event of an accidental deployment.

⚠ WARNING: After deployment, the air bag surface can contain deposits of sodium hydroxide, a product of the gas generant combustion that is irritating to the skin. Wash your hands with soap and water afterwards.

⚠ WARNING: Never probe the connectors on the air bag module. Doing so can result in air bag deployment, which can result in personal injury.

⚠ WARNING: The safety belt buckle pretensioner and safety belt retractor pretensioner are pyrotechnic devices. Never probe a pretensioner electrical connector. Doing so could result in pretensioner or air bag deployment and could result in personal injury.

⚠ WARNING: Vehicle sensor orientation is critical for proper system operation. If a vehicle equipped with an air bag supplemental restraint system (SRS) is involved in a collision, inspect the sensor mounting bracket and wiring pigtail for deformation. Replace and properly position the sensor or any other damaged supplemental restraint system (SRS) components whether or not the air bag is deployed.

⚠ WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.

NOTE: If a seat equipped with a seat mounted side air bag and/or a safety belt pretensioner (if equipped) system is being serviced, **the air bag system must be deactivated.**

NOTE: Restraint system diagnostic tools **MUST** be installed under the seats in the seat side air bag (if equipped) and safety belt pretensioner (if equipped) to floor connectors.

NOTE: Diagnostics or repairs are not to be performed on a seat equipped with a seat side air bag with the seat in the vehicle. Prior to attempting to diagnose or repair a seat concern when equipped with a seat side air bag, the seat must be removed from the vehicle and the restraint system diagnostic tools must be installed in the seat side air bag electrical connectors. **The restraint system diagnostic tools must be removed prior to operating the vehicle over the road.**

NOTE: After diagnosing or repairing an SRS, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: After diagnosing or repairing a seat system, **the restraint system diagnostic tools must be removed before operating the vehicle over the road.**

NOTE: The SRS must be fully operational and free of faults before releasing the vehicle to the customer.

1. ⚠ **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

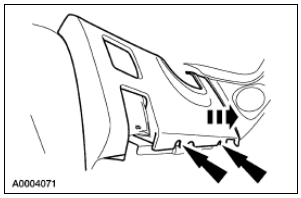
   Please refer to the appropriate vehicle workshop manual to determine location of the front air bag sensors.

   The side air bag sensors are located at or near the base of the B-pillar.

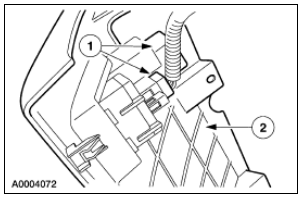
   To deplete the backup power supply energy, Disconnect the battery ground cable and wait at least one minute to allow for the depletion of the restraint system backup power supply. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

   Disconnect the battery ground cable and wait at least one minute to allow for the depletion of the restraint system backup power supply. For additional information, refer to Section 414-01 .

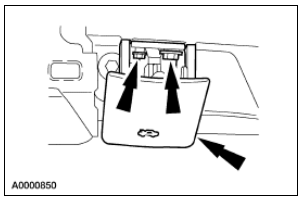
2. Remove the two screws and pull out on the lower steering column opening finish panel enough to access the electrical connectors.



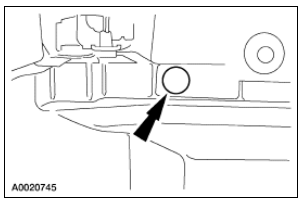
3. Remove the lower steering column opening finish panel.
   1. Disconnect the electrical connectors.
   2. Remove the lower steering column opening finish panel.



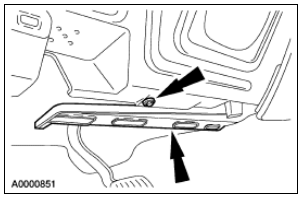
4. Remove the screws. Separate the hood latch release cable and handle assembly from the steering column opening reinforcement.



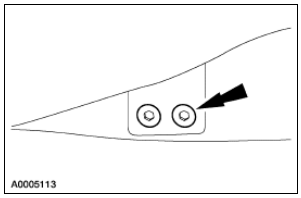
5. Remove the two pin-type retainers and the RH instrument panel insulator.
   - Disconnect the courtesy lamp.



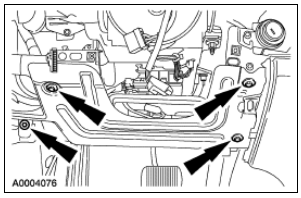
6. Remove the screw and the heater duct.



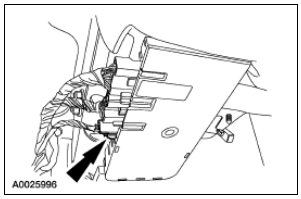
7. Loosen the two driver-side instrument panel tunnel brace bolts.
   - Position the carpet aside to gain access to the bolts.



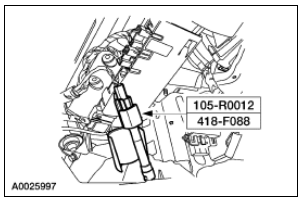
8. Remove the screws and the steering column opening reinforcement.



9. Disconnect the clockspring electrical connector at the base of the steering column.

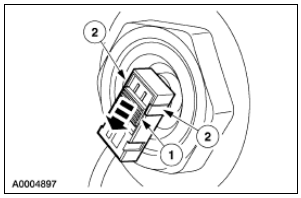


10. Attach the restraint system diagnostic tool to the vehicle harness side of the clockspring electrical connector.

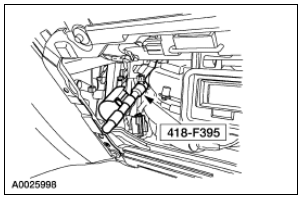


11. Remove the glove compartment. For additional information, refer to Section 501-12 .

12. Disconnect the passenger air bag module electrical connector.
    1. Reaching into the glove box opening toward the center of the instrument panel, under the cross-car beam, slide and disengage the passenger air bag module electrical connector locking clip.
    2. Push in on the two release tabs and disconnect the passenger air bag module electrical connector.



13. Attach the restraint system diagnostic tool to the vehicle harness side of the passenger air bag electrical connector.



14. Connect the battery ground cable. For additional information, refer to Section 414-01 .

15. Move and tilt the front seats to their highest and most forward position.

16. ⚠ **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.**

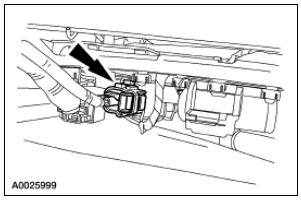
    Please refer to the appropriate vehicle workshop manual to determine location of the front air bag sensors.

    The side air bag sensors are located at or near the base of the B-pillar.

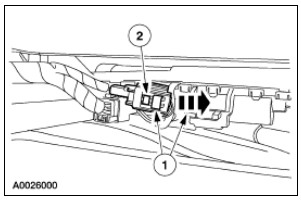
    To deplete the backup power supply energy, Disconnect the battery ground cable and wait at least one minute to allow for the depletion of the restraint system backup power supply. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute to allow for the depletion of the restraint system backup power supply. For additional information, refer to Section 414-01 .

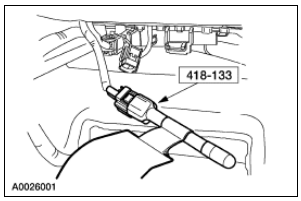
17. From under the passenger seat, release the tab on the connector bracket and remove the passenger seat side air bag electrical connector.



18. Disconnect the passenger seat side air bag electrical connector.
    1. Slide and disengage the passenger seat side air bag electrical connector locking clip.
    2. Push in to release the tab and disconnect the passenger seat side air bag electrical connector.



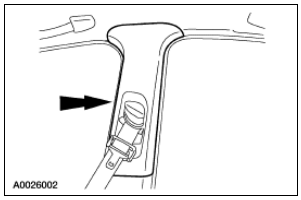
19. Attach the restraint system diagnostic tool to the passenger seat side air bag floor electrical connector.



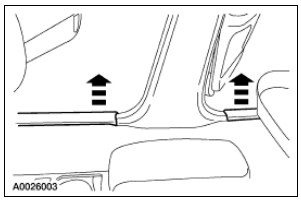
20. Remove the passenger side B-pillar weatherstripping.

21. Position the safety belt D-ring to its highest point.

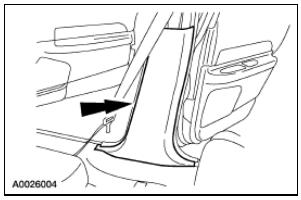
22. Remove the passenger side B-pillar upper trim panel.



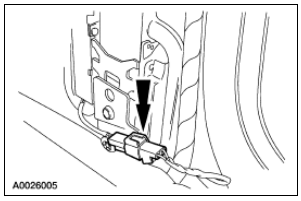
23. Remove the passenger side front and rear door scuff plates.



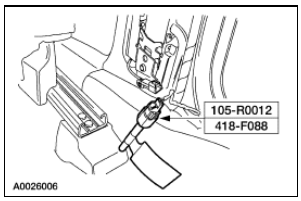
24. Remove the passenger side B-pillar lower trim panel.



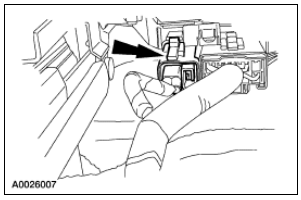
25. Disconnect the passenger side safety belt retractor pretensioner floor electrical connector.



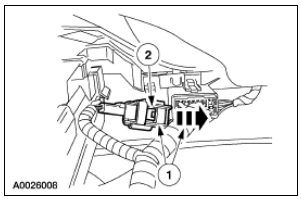
26. Attach the restraint system diagnostic tool to the passenger side safety belt retractor pretensioner floor electrical connector.



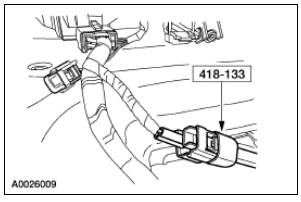
27. From under the driver seat, release the tab on the connector bracket and remove the driver seat side air bag electrical connector.



28. Disconnect the driver seat side air bag electrical connector.
    1. Slide and disengage the driver seat side air bag electrical connector locking clip.
    2. Push down to release the tab and disconnect the driver seat side air bag electrical connector.



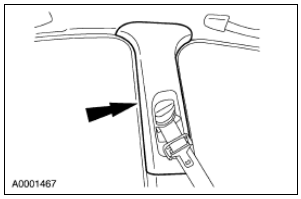
29. Attach the restraint system diagnostic tool to the driver seat side air bag floor electrical connector.



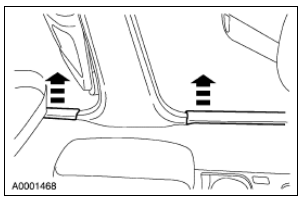
30. Remove the driver side B-pillar weatherstripping.

31. Position the safety belt D-ring to its highest point.

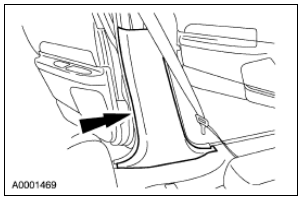
32. Remove the driver side B-pillar upper trim panel.



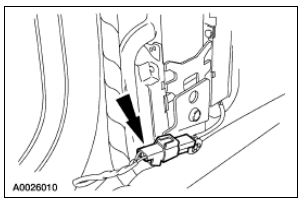
33. Remove the driver side front and rear door scuff plates.



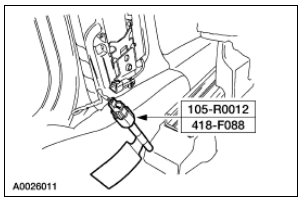
34. Remove the driver side B-pillar lower trim panel.



35. Disconnect the driver side safety belt retractor pretensioner electrical connector.



36. Attach the restraint system diagnostic tool to the driver side safety belt retractor pretensioner floor electrical connector.



37. Connect the battery ground cable. For additional information, refer to Section 414-01 .

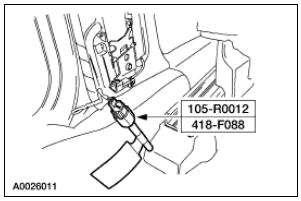
38. With the restraint system diagnostic tools installed at all deployable devices, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

39. Disconnect the battery ground cable and wait at least one minute to allow for the depletion of the restraint system backup power supply. For additional information, refer to Section 414-01 .

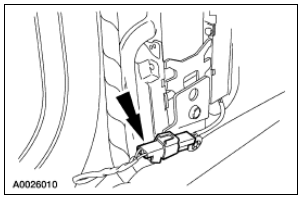
Reactivation

⚠ WARNING: To reduce the risk of serious personal injury, read and follow all warnings and notes at the beginning of the deactivation procedure.

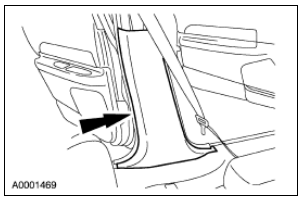
1. Remove the restraint system diagnostic tool from the driver side safety belt retractor pretensioner floor electrical connector.



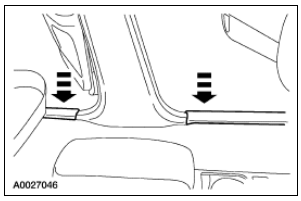
2. Connect the driver side safety belt retractor pretensioner electrical connector.



3. Install the driver side B-pillar lower trim panel.

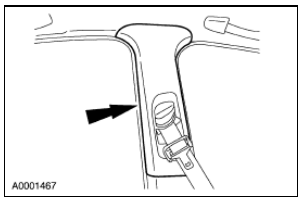


4. Install the driver side front and rear door scuff plates.



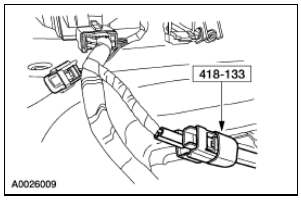
5. **NOTE:** Position the safety belt D-ring to its highest point.

   Install the driver side B-pillar upper trim panel.

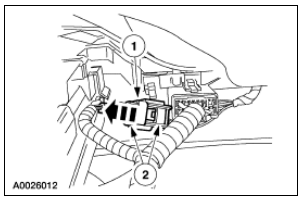


6. Install the driver side B-pillar weatherstripping.

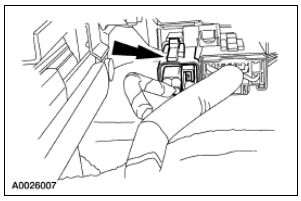
7. Remove the restraint system diagnostic tool from the driver seat side air bag floor electrical connector.



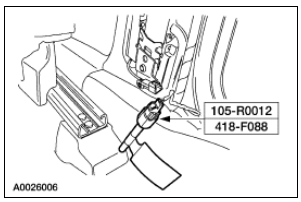
8. Connect the driver seat side air bag electrical connector.
    1. Connect the driver seat side air bag electrical connector.
    2. Slide and engage the driver seat side air bag electrical connector locking clip.



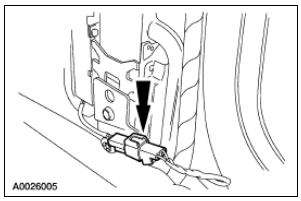
9. Install the driver seat side air bag electrical connector onto the connector bracket under the driver seat.



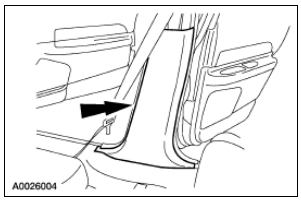
10. Remove the restraint system diagnostic tool from the passenger side safety belt retractor pretensioner electrical connector.



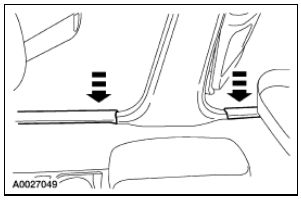
11. Connect the passenger side safety belt retractor pretensioner electrical connector.



12. Install the passenger side B-pillar lower trim panel.

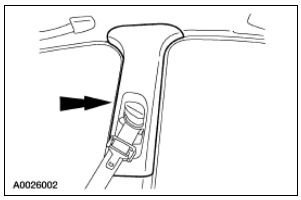


13. Install the passenger side front and rear door scuff plates.



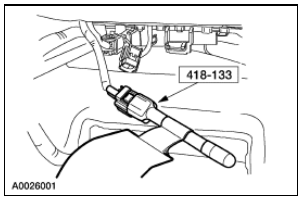
14. **NOTE:** Position the safety belt D-ring to its highest point.

    Install the passenger side B-pillar upper trim panel.

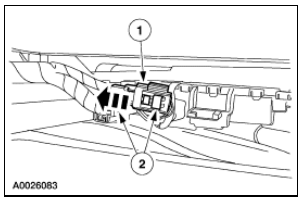


15. Install the passenger side B-pillar weatherstripping.

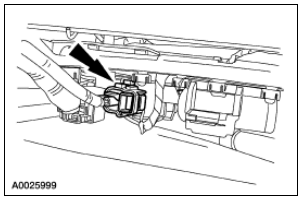
16. Remove the restraint system diagnostic tool from the passenger seat side air bag floor electrical connector.



17. Connect the passenger seat side air bag electrical connector.
    1. Connect the passenger seat side air bag electrical connector.
    2. Slide and engage the passenger seat side air bag electrical connector locking clip.



18. Install the passenger seat side air bag electrical connector onto the connector bracket under the passenger seat.



19. Connect the battery ground cable. For additional information, refer to Section 414-01 .

20. Position the front seats rearward.

21. ⚠ **WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any front or side air bag**

supplemental restraint system (SRS) components and before servicing, replacing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

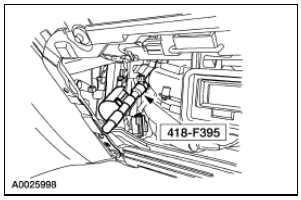
Please refer to the appropriate vehicle workshop manual to determine location of the front air bag sensors.

The side air bag sensors are located at or near the base of the B-pillar.

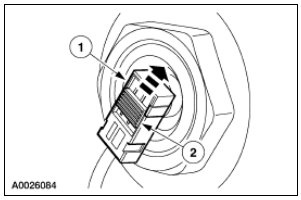
To deplete the backup power supply energy, Disconnect the battery ground cable and wait at least one minute to allow for the depletion of the restraint system backup power supply. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

Disconnect the battery ground cable and wait at least one minute to allow for the depletion of the restraint system backup power supply. For additional information, refer to Section 414-01 .

22. Remove the restraint system diagnostic tool from the vehicle harness side of the passenger air bag electrical connector.

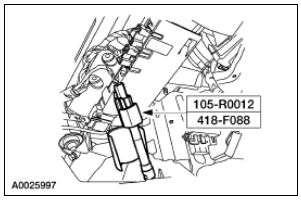


23. Connect the passenger air bag module electrical connector.
    1. Reach into the glove box opening toward the center of the instrument panel, under the cross-car beam and connect the passenger air bag module electrical connector.
    2. Slide and engage the passenger air bag module electrical connector locking clip.

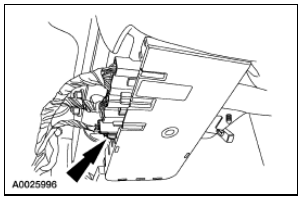


24. Install the glove compartment. For additional information, refer to Section 501-12 .

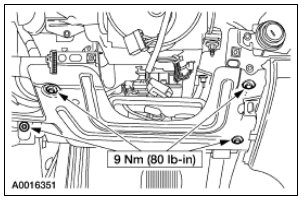
25. Remove the restraint system diagnostic tool from the vehicle harness side of the clockspring electrical connector.



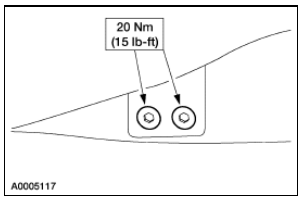
26. Connect the clockspring electrical connector at the base of the steering column.



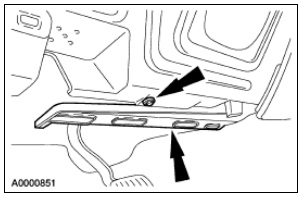
27. Position the steering column opening reinforcement and install the screws.



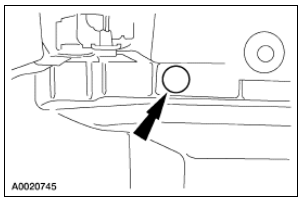
28. Tighten the two driver-side instrument panel tunnel brace bolts.
    - Reposition the carpet.



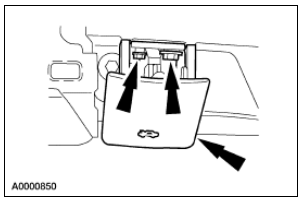
29. Position the heater duct and install the screw.



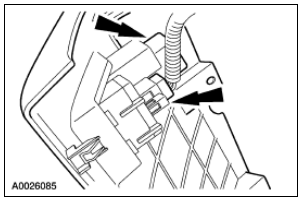
30. Install the RH instrument panel insulator and the two pin-type retainers.
    - Connect the courtesy lamp.



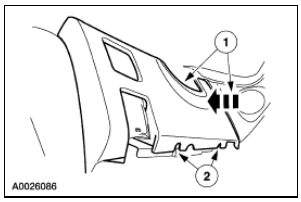
31. Position the hood latch release cable and handle assembly to the steering column opening reinforcement and install the screws.



32. Connect the electrical connectors to the switches in the lower steering column opening finish panel.



33. Install the lower steering column opening finish panel to the instrument panel.
    1. Position the lower steering column opening finish panel to the instrument panel and push in, seating the retaining clips.
    2. Install the screws.



34. Connect the battery ground cable. For additional information, refer to Section 414-01 .

35. ⚠ **WARNING: The restraint system diagnostic tool is for restraint system service only. Remove from vehicle prior to road use. Failure to remove could result in injury and possible violation of vehicle safety standards.**

    With all the restraint system diagnostic tools removed, prove out the supplemental restraint system (SRS). For additional information, refer to Section 501-20B .

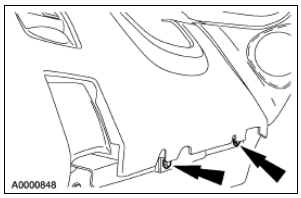
36. Check the active restraint system for correct operation. For additional information, refer to Section 501-20A .

Ignition Switch Lock Cylinder

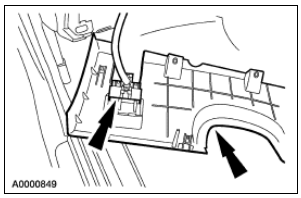
Removal and Installation

1. Disconnect the battery ground cable and wait at least one minute to allow for the depletion of the restraint system backup power supply. For additional information, refer to Section 414-01 .

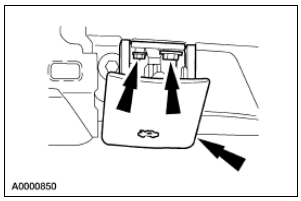
2. Remove the bolts. Detach the steering column opening cover.



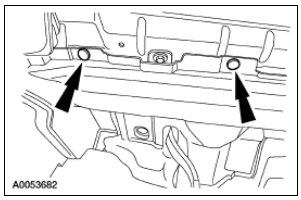
3. Disconnect the electrical connector. Remove the steering column opening cover.



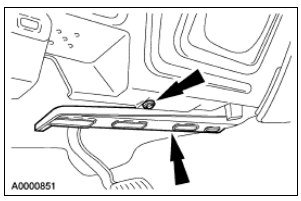
4. Remove the bolts and the hood release handle assembly.



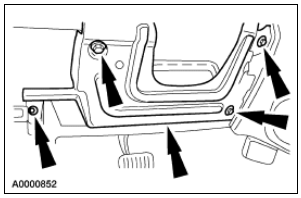
5. Remove the pushpins and the insulator panel.



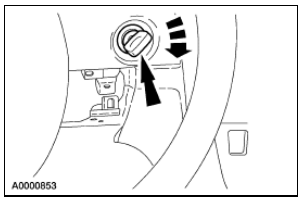
6. Remove the bolt and the heater duct.



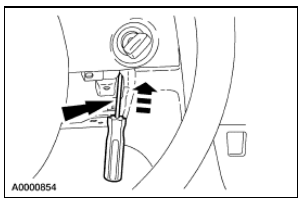
7. Remove the bolts and the steering column opening cover reinforcement.

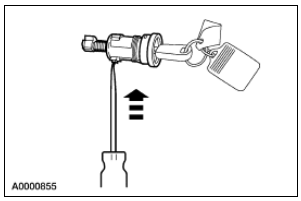


8. Turn the ignition switch to the RUN position.



9. Using a small flat-blade screwdriver, depress the ignition switch lock cylinder tab. Remove the ignition switch lock cylinder.

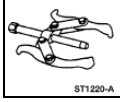




10. To install, reverse the removal procedure.
    - Verify correct operation of the ignition switch lock cylinder.

Steering Wheel

Special Tool(s)

 ST1220-A	Remover, Differential Bearing 205-116 (T77F-4220-B1)

Removal

1. Center the steering wheel to the straight-ahead position.

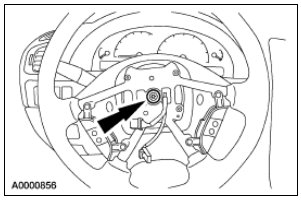
2. Disconnect the battery ground cable and wait at least one minute to allow for the depletion of the restraint system backup power supply. For additional information, refer to Section 414-01 .

3. ⚠ **WARNING: To avoid the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation procedure.**

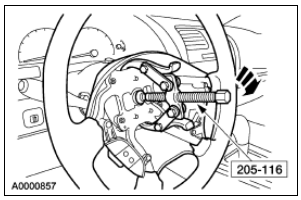
   Deactivate the supplemental restraint system. For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

4. Remove the horn blow switch. For additional information, refer to Section 413-06 .

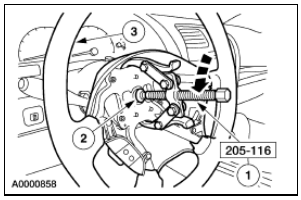
5. Loosen the steering wheel retaining bolt.



6. Using the special tool, loosen the steering wheel.

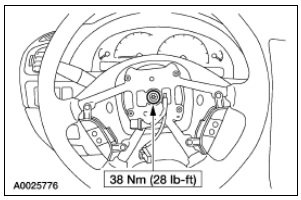


7. Remove the steering wheel.
   1. Remove the special tool.
   2. Remove and discard the steering wheel retaining bolt.
   3. Remove the steering wheel.



Installation

1. Install the steering wheel and a new steering wheel retaining bolt.



2. Install the horn blow switch. For additional information, refer to Section 413-06 .

3. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation procedure.**

   Reactivate the supplemental restrain system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

Clockspring

Removal and Installation

For additional information, refer to Section 501-20B .

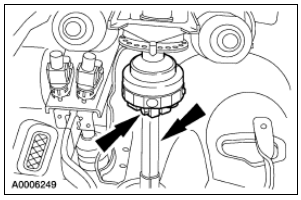
Steering Column

Removal

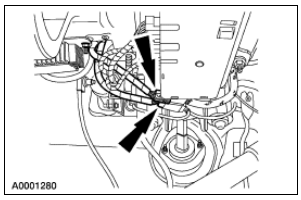
All vehicles

1. Prepare the vehicle for steering column removal.
    1. Disconnect the battery ground cable for at least one minute to allow for the depletion of the restraint system backup power supply. For additional information, refer to Section 414-01 .
    2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation procedure.**

       Deactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.
    3. Remove the clockspring. For additional information, refer to Section 501-20B .
2. Remove and discard the steering column shaft pinch bolt. Detach the intermediate shaft from the steering column yoke.

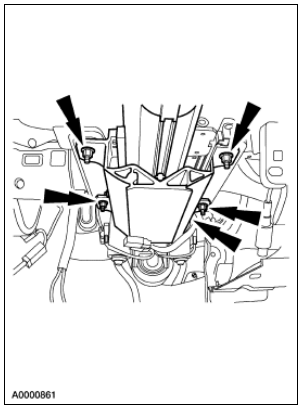


3. Disconnect the electronic steering sensor and steering column release motor harness electrical connectors.



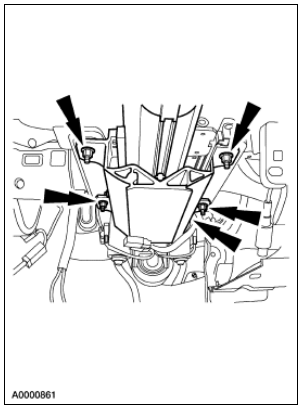
Vehicles with automatic transmission

4. While supporting the steering column, remove and discard the lock nuts. Remove the steering column.

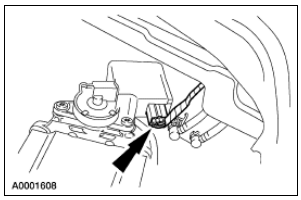


Vehicles with manual transmission

5. While supporting the steering column, remove and discard the lock nuts. Lower the steering column.



6. Disconnect the steering wheel lock actuator electrical connector.

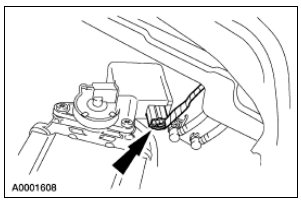


7. Remove the steering column.

Installation

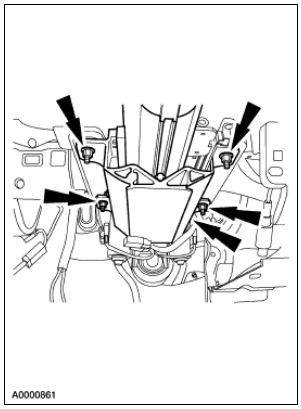
Vehicles with manual transmission

1. Connect the steering wheel lock actuator electrical connector.

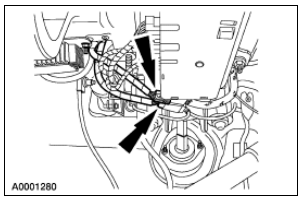


All vehicles

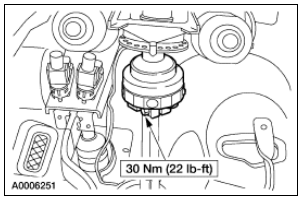
2. Position the steering column and loosely install the bolts.



3. Connect the electronic steering sensor and the steering column release motor electrical connectors.



4. Attach the intermediate shaft to the steering column yoke and install the pinch bolt.



5. Restore the vehicle to operating condition.
    1. Install the clockspring. For additional information, refer to Section 501-20B .
    2. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the supplemental restraint system (SRS) deactivation procedure.**

       Reactivate the supplemental restraint system (SRS). For additional information, refer to Supplemental Restraint System (SRS) Deactivation and Reactivation in this section.

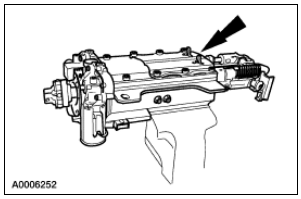
Tilt/Telescopic Motors

Removal and Installation

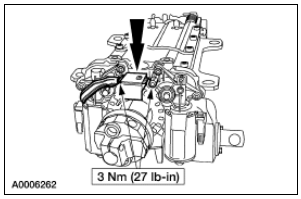
1. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the steering column removal and installation procedure.**

   Remove the steering column. For additional information, refer to Steering Column in this section.

2. Place the steering column in a vise.

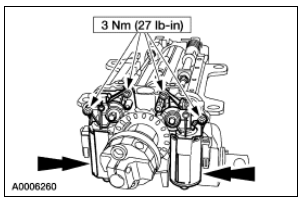


3. Remove the screws and the electronic steering sensor (18B015).



4. **NOTE:** Do not disconnect the steering column release motor harness electrical connectors from the steering column release motor assemblies (3D538).

   Remove the screws and the steering column release motor assemblies.



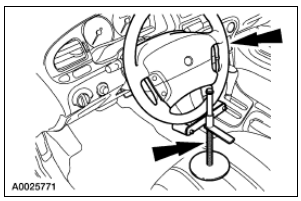
5. ⚠ **WARNING: To reduce the risk of serious personal injury, read and follow all warnings, cautions, notes and instructions in the steering column procedure.**

   To install, reverse the removal procedure.

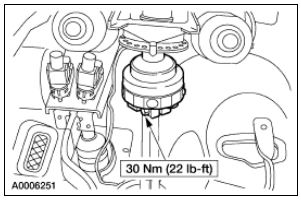
Steering Column Shaft Intermediate

Removal and Installation

1. Hold the steering wheel in the straight forward position using a suitable holding device.



2. Remove the pinch bolt and detach the intermediate shaft from the steering column yoke.
   - Discard the bolt.

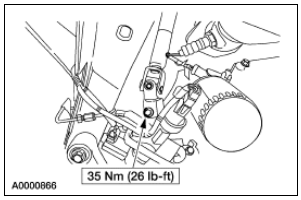


3. Raise and support the vehicle. For additional information, refer to Section 100-02 .

4. **⚠ CAUTION: Do not allow the steering wheel to rotate while the steering column intermediate shaft is disconnect or damaged to the clockspring can result. If there is evidence that the wheel has rotated, the clockspring must be removed and recentered. For additional information, refer to Section 501-20B .**

   Remove the pinch bolt and detach the coupler.

   - Discard the bolt.



5. Remove the intermediate shaft.

6. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Battery ground cable bolt	10		89
Steering column lock actuator screw	14	10	

Steering Column Switches

The steering column switches system consists of the following components:

- ignition switch (11572)
- multifunction switch (13K359)
- steering column lock actuator (manual transmission only)

The ignition switch is mounted in the instrument panel to the RH side of the steering column and is activated by rotating the ignition key in the ignition switch lock cylinder.

The integrated multifunction switch is mounted to the steering column and controls the turn signals, hazard flasher, windshield wiper/washer control, and headlamp dimmer/flash-to-pass.

The steering column lock actuator will unlock when a valid ignition key is inserted into the ignition switch lock cylinder. The steering column lock actuator will only lock when the ignition key is removed, and both the vehicle messages for vehicle speed and engine rpm are not present on the standard corporate protocol (SCP) link. Power must not be enabled to the steering column lock actuator while the engine is running. While the steering column lock actuator is in the locked position, the vehicle will be inhibited from cranking.

The steering column lock actuator receives power from the REM, ground from the FEM, and exchanges security-related communication messages with the instrument cluster (IC) module over the SCP link.

Steering Column Switches

Special Tool(s)

 ST1137-A	73 III Automotive Meter or equivalent 105-R0057
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Refer to Wiring Diagrams Cell 13 for schematic and connector information.

Refer to Wiring Diagrams Cell 90 for schematic and connector information.

Refer to Wiring Diagrams Cell 81 for schematic and connector information.

Refer to Wiring Diagrams Cell 85 for schematic and connector information.

Refer to Wiring Diagrams Cell 128 for schematic and connector information.

Inspection and Verification

1. Verify the customer's concern by operating the ignition switch, the multifunction switch, and the steering column lock actuator (if equipped) (manual transmission only) on the steering column.

2. Visually inspect for obvious signs of mechanical and electrical damage; refer to the following chart:

Visual Inspection Chart

Mechanical	Electrical
• Multifunction switch • Ignition key • Ignition switch • Steering column • Wiper/washer switch • Steering column lock (SCL) actuator (if equipped)	• Circuit • Central junction box (CJB) Fuse: ♦ 201 (5A) ♦ 202 (5A) ♦ 203 (5A) ♦ 204 (5A) ♦ 205 (5A) ♦ 213 (5A) ♦ 214 (10A) ♦ 216 (5A)

	♦ 217 (5A) ♦ 226 (3A) ♦ 227 (10A) ♦ 229 (5A) • Underhood auxiliary junction box (AJB) Fuse: ♦ 102 (10A) ♦ 120 (30A) • Battery junction box (BJB) Fuse: ♦ 402 (10A) ♦ 406 (10A) ♦ 422 (20A) • Relay

3. If an obvious cause for an observed or reported concern is found, correct the cause before proceeding to the next step.

4. If the diagnostic tool does not power up, refer to the diagnostic tool manual.

5. **NOTE:** The SCL actuator will only allow communication with a tester after the SCL actuator has been activated. To activate the SCL actuator, open the driver door and **do not** put the key in the ignition (or alternatively, you can press one of the buttons on the key fob while there is no key in the ignition). The SCL actuator will stay activated for 30 minutes after the driver door is opened (or a key fob button is pressed).

   If equipped with SCL actuator (manual transmission vehicles only), and the concern remains after inspection, connect the diagnostic tool. The diagnostic tool will receive power through the diagnostic connector. If the diagnostic tool does not communicate, refer to the diagnostic tool manual.

6. Carry out the DATA LINK DIAGNOSTIC TEST. If the diagnostic tool responds with:
   - CKT914, CKT915 or CKT70-ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for front electronic module (FEM), Go To Pinpoint Test A .
   - NO RESP/NOT EQUIP for rear electronic module (REM), Go To Pinpoint Test B .
   - NO RESP/NOT EQUIP for instrument cluster (IC), Go To Pinpoint Test D .
   - NO RESP/NOT EQUIP for steering column lock module (SCLM), ignore this message and proceed to specific data link diagnostic test for the steering column lock module as follows:

     NOTE: Ignition key must be kept out of the ignition switch even though the diagnostic tool may request ignition to the RUN position.

     NOTE: Ignore NO RESP/NOT EQUIP messages for all modules except the steering column lock module for this test.

     Turn key to OFF, remove key from ignition switch, close the driver door, open the driver door. Carry out the DATA LINK DIAGNOSTIC TEST FOR THE SCL ACTUATOR. If the diagnostic tool responds with:
   - NO RESP/NOT EQUIP for steering column lock module (SCLM), Go To Pinpoint Test C .
   - Otherwise, retrieve and record the continuous diagnostic trouble codes (DTCs) for the SCLM, , erase the continuous DTCs, insert the key into the ignition switch, turn the ignition switch to RUN, Turn the ignition switch to OFF, remove the key from the ignition switch, close the driver door, open the driver door, record new continuous DTCs for the SCLM.

7. If the DTCs retrieved are related to the concern, go to the SCL actuator Diagnostic Trouble Code (DTC) Index.

8. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

FEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1319	Driver Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1327	Passenger Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1342	ECU Is Defective	FEM	CLEAR the DTC. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new FEM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test.
B1438	Wiper Mode Select Switch Circuit Failure	FEM	REFER to Section 501-16 .
B1446	Wiper Park Sense Circuit Failure	FEM	REFER to Section 501-16 .
B1479	Wiper Washer Fluid Level Sensor Circuit Failure	FEM	REFER to Section 413-01 .
B1499	Lamp Turn Signal Left Circuit Failure	FEM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1503	Lamp Turn Signal Right Circuit Failure	FEM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1519	Hood Switch Circuit Failure	FEM	REFER to Section 419-01A .
B1567	Lamp Headlamp High-Beam Circuit Failure	FEM	REFER to Section 417-01 .
B1676	Battery Pack Voltage Out of Range	FEM	REFER to Section 414-00 .
B1794	Lamp Headlamp Low-Beam Circuit Failure	FEM	REFER to Section 417-01 .
B2214	Window Passenger Front Up Switch Short to Battery	FEM	REFER to Section 501-11 .
B2215	Window Passenger Front Down Switch Short to Battery	FEM	REFER to Section 501-11 .
B2312	Mirror Passenger Horizontal Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2316	Mirror Passenger Vertical Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2443	Powertrain Performance Mode Switch Circuit Failure	FEM	Not Used

B2477	Module Configuration Failure	FEM	REFER to Section 418-01 .
C1284	Oil Pressure Switch Failure	FEM	REFER to Section 413-01 .
C1446	Brake Switch Circuit Failure	FEM	REFER to Section 413-01 .
C1924	VAPS Solenoid Actuator Output Circuit Short to Ground	FEM	REFER to Section 211-00 .
C1925	VAPS Solenoid Actuator Return Circuit Failure	FEM	REFER to Section 211-00 .
U1027	SCP (J1850) Invalid or Missing Data for Engine RPM	PCM	CARRY OUT the PCM self-test.
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission / Transaxle / PRNDL	PCM	CARRY OUT the PCM self-test.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the ICM self-test.
U1222	SCP (J1850) Invalid or Missing Data for Interior Lamps	ICM	CARRY OUT the ICM self-test.
U1227	SCP (J1850) Invalid or Missing Data for Body Status Request	ICM	CARRY OUT the ICM self-test.

REM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1201	Fuel Sender Circuit Failure	REM	REFER to Section 413-01 .
B1300	Power Door Lock Circuit Failure	REM	REFER to Section 501-14B .
B1310	Power Door Unlock Circuit Failure	REM	REFER to Section 501-14B .
B1331	Decklid Ajar Rear Door Circuit Failure	REM	REFER to Section 417-02 .
B1335	Door Ajar RR Circuit Failure	REM	REFER to Section 417-02 .
B1342	ECU Is Defective	REM	CLEAR the DTC. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new REM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test.
B1483	Brake Pedal Input Circuit Failure	REM	REFER to Section 417-01 .
B1499	Lamp Turn Signal Left Circuit Failure	REM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	REM	REFER to Section 417-01 .
B1503	Lamp Turn Signal Right Circuit Failure	REM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	REM	REFER to Section 417-01 .
B1551	Decklid Release Circuit Failure	REM	REFER to Section 501-14B .
B1571	Door Ajar LR Circuit Failure	REM	REFER to Section 417-02 .
B1676	Battery Pack Voltage Out of Range	REM	REFER to Section 414-00 .

B2172	Inertia Switch Input Circuit Open	REM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
B2174	Window Driver Rear Remote Up Switch Short to Battery	REM	REFER to Section 501-11 .
B2178	Window Driver Rear Remote Down Switch Short to Battery	REM	REFER to Section 501-11 .
B2190	Window Passenger Rear Remote Up Switch Short to Battery	REM	REFER to Section 501-11 .
B2194	Window Passenger Rear Remote Down Switch Short to Battery	REM	REFER to Section 501-11 .
B2477	Module Configuration Failure	REM	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/ PRNDL	PCM	CARRY OUT the PCM self-test.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the ICM self-test

SCL Actuator Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1342	ECU Is Defective	SCL Actuator	CLEAR the DTCs. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new SCL actuator. REFER to Steering Column Lock Actuator - Manual Transmission .
B2162	Data Mismatch #2 (received data does not match what was expected)	SCL Actuator	CARRY OUT the steering column lock module parameter reset. Refer to Steering Column Lock Module Parameter Reset .
B2168	Unable to Confirm Unlock Condition	SCL Actuator	Go To Pinpoint Test I .
B2169	Unable to Confirm Lock Condition	SCL Actuator	Go To Pinpoint Test I .
B2170	Steering Column Lock Switch Circuit Failure	SCL Actuator	INSTALL a new SCL actuator. REFER to Steering Column Lock Actuator - Manual Transmission .

Instrument Cluster Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1201	Fuel Sender Circuit Failure	ICM	REFER to Section 413-01 .
B1205	EIC Switch-1 Assembly Circuit Failure	ICM	INSTALL a new instrument cluster; REFER to Section 413-01 . TEST the system for normal operation.
B1209	EIC Switch-2 Assembly Circuit Failure	ICM	INSTALL a new instrument cluster; REFER to Section 413-01 . TEST the system for normal operation.
B1213	Anti-Theft Number of Programmed Keys Is Below Minimum	ICM	REFER to Section 419-01B .

B1246	Dim Panel Potentiometer Switch Circuit Failure	ICM	REFER to Section 413-00 .
B1342	ECU Is Defective	ICM	REFER to Section 413-01 .
B1352	Ignition Key-In Circuit Failure	ICM	REFER to Section 413-09 .
B1470	Lamp Headlamp Input Circuit Failure	ICM	REFER to Section 417-01 .
B1567	Lamp Headlamp High Beam Circuit Failure	ICM	REFER to Section 417-01 .
B1600	PATS Ignition Key Transponder Signal Is Not Received	ICM	REFER to Section 419-01B .
B1601	PATS Received Incorrect Key-Code From Ignition Key Transponder	ICM	REFER to Section 419-01B .
B1602	PATS Received Invalid Format of Key-Code From Ignition Key Transponder	ICM	REFER to Section 419-01B .
B1676	Battery Pack Voltage Out of Range	ICM	REFER to Section 413-01 .
B1681	PATS Transceiver Module Signal Is Not Received	ICM	REFER to Section 419-01B .
B1689	Autolamp Delay Circuit Failure	ICM	REFER to Section 417-01 .
B1875	Turn Signal / Hazard Switch Signal Circuit Failure	ICM	REFER to Section 417-01 .
B2103	Antenna Not Connected	ICM	REFER to Section 419-01B .
B2139	Security Data Mismatch (Receive Data Does Not Match What Was Expected)	ICM	REFER to Section 419-01A .
B2141	NVM Configuration Failure	ICM	REFER to Section 419-01B .
B2143	NVM Memory Failure	ICM	REFER to Section 419-01B .
B2162	Security Data Mismatch #2 (Receive Data Does Not Match What Was Expected)	ICM	REFER to Section 419-01B .
B2328	Column Reach Feedback Potentiometer Circuit Failure	ICM	REFER to Section 211-04 .
B2332	Column Tilt Feedback Potentiometer Circuit Failure	ICM	REFER to Section 211-04 .
B2351	Steering Column Switch Circuit Failure	ICM	REFER to Section 211-04 .
B2431	Transponder Programming Failed	ICM	REFER to Section 419-01A .
B2472	Fog Lamp Switch Failure	ICM	REFER to Section 417-01 .
B2477	Module Configuration Failure	ICM	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS/TC/IVD	CARRY OUT the ABS/TC/IVD self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/ PRNDL	PCM	CARRY OUT the PCM self-test.
U1073	SCP (J1850) Invalid or Missing Data for Engine Coolant Fluid Temperature	PCM	CARRY OUT the PCM self-test.
U1123	SCP (J1850) Invalid or Missing Data for Odometer Rolling Count	ABS/TC/IVD	CARRY OUT the ABS/TC/IVD self-test.
U1131	SCP (J1850) Invalid or Missing Data for Fuel System	ICM	REFER to Section 413-01 .
U1147	SCP (J1850) Invalid or Missing Data for Vehicle Security System	PCM	CARRY OUT the PCM self-test.

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE FRONT ELECTRONIC MODULE

PINPOINT TEST B: NO COMMUNICATION WITH THE REAR ELECTRONIC MODULE

PINPOINT TEST C: NO COMMUNICATION WITH THE STEERING COLUMN LOCK ACTUATOR

PINPOINT TEST D: NO COMMUNICATION WITH THE INSTRUMENT CLUSTER MODULE

PINPOINT TEST E: THE IGNITION SWITCH IS INOPERATIVE

PINPOINT TEST F: NO POWER IN ACC

PINPOINT TEST G: NO POWER IN START

PINPOINT TEST H: THE MULTIFUNCTION SWITCH/HAZARD SWITCH DOES NOT OPERATE CORRECTLY

PINPOINT TEST I: THE STEERING COLUMN LOCK DOES NOT OPERATE CORRECTLY

Steering Column Lock Module Parameter Reset

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

NOTE: The SCL actuator will only allow communication with a tester after the SCL actuator has been activated. To activate the SCL actuator, open the driver door and **do not** put the key in the ignition (or alternatively, you can press one of the buttons on the key fob while there is no key in the ignition). The SCL actuator will stay activated for 30 minutes after the driver door is opened (or a key fob button has been pressed).

1. Remove the ignition key from the ignition switch.
2. Close and open the driver door (must complete steps 3-6 within 30 minutes of completing step 2).
3. Connect the diagnostic tool (use service function card).
4. Select SCLM.
5. Select ENTER SECURITY ACCESS. Wait eight minutes for security access to be granted.
6. Select PARAMETER RESET.
7. Insert key into ignition switch and place in the RUN position.
8. Select ICM.
9. Select ENTER SECURITY ACCESS. Wait 10 minutes for security access to be granted.
10. Select RESET SCLM PARAMETER.
11. Disconnect the diagnostic tool.
12. Place ignition key in the OFF position.
13. Remove ignition key from ignition switch.
14. Insert ignition key into ignition switch.
15. Place ignition key in the RUN position.
16. Remove the ignition key.

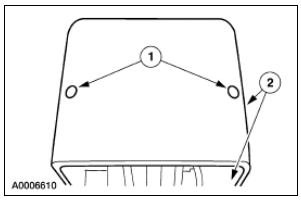
Multifunction Switch

Removal and Installation

1. Remove the steering wheel. For additional information, refer to Section 211-04 .

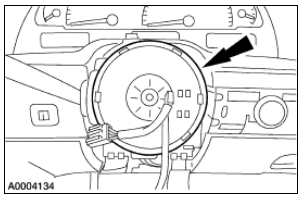
2. Remove the instrument panel cluster finish panel. For additional information, refer to Section 501-12 .

3. Remove the upper and lower steering column shrouds.
    1. Remove the screws.
    2. Remove the upper and lower steering column shrouds.

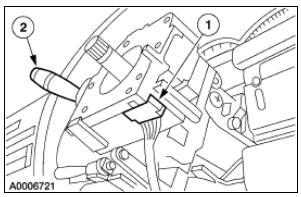


4. ⚠ **CAUTION: Apply two strips of masking tape across the air bag sliding contact to prevent rotation.**

    Depress the three clips and position the air bag sliding contact aside.



5. Remove the multifunction switch.
    1. Disconnect the electrical connector.
    2. Remove the multifunction switch.



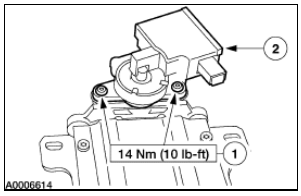
6. To install, reverse the removal procedure.

Steering Column Lock Actuator Manual Transmission

Removal

1. Remove the steering column. For additional information, refer to Section 211-04 .

2. Remove the steering column lock actuator.
    1. Remove the screws.
    2. Remove the steering column lock actuator.



Installation

1. To install, reverse the removal procedure.
    - After the installation is complete, carry out the steering column lock module parameter reset. Refer to Steering Column Lock Module Parameter Reset .

-- C --

Cabin Air Filter

Cable Adjustment

Cable

REM & INST: Antenna

REM & INST: Automatic Transaxle/Transmission External Controls

Camber and Caster Adjustment

Camshaft End Play OHC Engines

Camshaft Journal Clearance, Plastigage Method

Camshaft Journal Diameter

Camshaft Lobe Lift

Camshaft Position (CMP) Sensor 3.0L

Camshaft Position (CMP) Sensor 3.9L

Camshaft Runout

Camshaft Lobe Surface

Camshaft

Camshafts LH

Camshafts RH

Canister Vent Solenoid Closing Procedure

Catalyst Monitor Sensor 3.0L (A/T), 3.9L

Catalyst Monitor Sensor 3.0L (M/T)

Catalytic Converter

Cellular Phone Antenna

Center Registers

Center Support

Charging System General Information, Section Table of Contents

Charging System

DESC & OPER: Charging System - General Information

DIAG & TEST: Charging System - General Information

Child Safety Seat Tether Anchor - LATCH

Child Safety Seat Tether Anchor

Climate Control Assembly

Climate Control System - General Information, Section Table of Contents

Climate Control System

DESC & OPER: Climate Control System - General Information

DIAG & TEST: Climate Control System - General Information

Clockspring

REM & INST: Steering Column

REM & INST: Supplemental Restraint System

Cluster Lens

Clutch and Clutch Field Coil

Clutch Controls

DESC & OPER: Clutch Controls

DIAG & TEST: Clutch Controls

Section Table of Contents

Clutch Master Cylinder

Clutch Pedal Position (CPP) Switch

Clutch Pedal

Clutch

DESC & OPER: Clutch

DIAG & TEST: Clutch

Section Table of Contents

Combination Fluid Cooler

Communication Circuit Wiring Repair

Communications Network

DESC & OPER: Module Communications Network

DIAG & TEST: Module Communications Network

Compact Disc (CD) Changer

Compass Calibration

Compass Zone Adjustment

Compressor Manifold and Tube Assembly

Condenser Core

Connecting Rod Bearing Journal Clearance

Connecting Rod Bend

Connecting Rod Bushing Diameter

Connecting Rod Cleaning

Connecting Rod Large End Bore

Connecting Rod Piston Pin Side Clearance

Connecting Rod Twist

Console Floor

DESC & OPER: Instrument Panel and Console

REM & INST: Instrument Panel and Console

Console Floor, Finish Panel Assembly

Contaminated Refrigerant Handling

Control Components

DESC & OPER: Control Components

Section Table of Contents

Coolant Inlet Pipe 3.0L

Coolant Outlet Pipe 3.0L

Coolant Outlet Pipe 3.9L

Cooling Fan Motor and Shroud

Cooling System Draining, Filling And Bleeding

Coupling - Spring Lock

Cowl Vent Screen

Crankcase Vent Oil Separator - 3.0L

Crankshaft End Play

Crankshaft Front Oil Seal

IN-VEH REP: Engine - 3.0L (4V)

IN-VEH REP: Engine - 3.9L

Crankshaft Main Bearing Journal - Clearance

Crankshaft Main Bearing Journal - Diameter

Crankshaft Main Bearing Journal - Taper

Crankshaft Position (CKP) Sensor - 3.0L

Crankshaft Position (CKP) Sensor - 3.9L

Crankshaft Pulley

IN-VEH REP: Engine - 3.0L (4V)

IN-VEH REP: Engine - 3.9L

Crankshaft Rear Oil Seal

IN-VEH REP: Engine - 3.0L (4V)

IN-VEH REP: Engine - 3.9L

Crankshaft Runout

Crankshaft - Connecting Rod Journal Taper, Out of Round

Crossmember - Front I-Brace Bracket

Crossmember - Front

Cylinder Block Core Plug Replacement

Cylinder Block - Distortion

Cylinder Bore - Cleaning

Cylinder Bore - Out-of-Round

Cylinder Bore - Taper

Cylinder Head LH

Cylinder Head RH

Cylinder Head Temperature (CHT) Sensor - 3.0L

Cylinder Head Temperature (CHT) Sensor - 3.9L

Cylinder Head - Distortion

Cylinder Head

DISASSEM & ASSEM OF SUBASSEM: Engine - 3.0L (4V)

DISASSEM & ASSEM OF SUBASSEM: Engine - 3.9L

IN-VEH REP: Engine - 3.9L

General Specifications

Item	Specification
A/C Compressor	
A/C compressor type	SC90V variable scroll
A/C compressor displacement	90 cc (5.5 cu in)
A/C compressor rotation	Clockwise
Magnetic Clutch	
Air gap between pulley and clutch plate	0.35-0.75 mm (0.014-0.030 in)
Coolant Hose Lubricant	
MERPOL®	ESE-M99B144-B
Refrigerant Lubricant	
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B
Capacity	207 ml (7 oz)
Refrigerant	
R-134a Refrigerant YN-19	WSH-M17B19-A
Capacity	0.79 kg (28 oz)
Refrigerant System Cleaner	
A/C Systems Flushing Solvent F4AZ-19579-A	
Evaporator Core Orifice	**Thermostatic expansion valve (TXV) system**
Color	N/A
Diameter	N/A
A/C Pressure Relief Valve [a]	
Open	3,792-4,137 kPa (550-600 psi)
A/C Cycling Switch	**N/A**
Pressure Cutoff Switch	**N/A**
A/C Pressure Sensor	**Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.**

[a] Manifold gauge set pressures may vary slightly depending on the distance between the service gauge port valve and the A/C pressure relief valve locations.

Torque Specifications

Description	Nm	lb-in
Peanut fitting nut	8	71

Climate Control System

⚠ WARNING: To avoid accidental deployment and possible injury, the air bag system backup power supply must be depleted before repairing any climate control components. To deplete the backup power supply, disconnect the battery ground cable and wait one minute.

⚠ WARNING: Carbon monoxide is colorless, odorless and dangerous. If it is necessary to operate the engine with vehicle in a closed area such as a garage, always use an exhaust collector to vent the exhaust gases outside the closed area.

⚠ WARNING: R-134a is classified as a safe refrigerant, but misuse can make it dangerous. The following precautions must be observed:

- Always wear safety goggles when repairing an air conditioning system.
- Avoid contact with liquid refrigerant R-134a. R-134a vaporizes at approximately -25°C (-13°F) under atmospheric pressure and it will freeze skin tissue.
- Never allow refrigerant R-134a gas to escape in quantity in an occupied space. R-134a is non-toxic, but it will displace the oxygen needed to support life.
- Never use a torch in an atmosphere containing R-134a gas. R-134a is non-toxic at all normal conditions, but when it is exposed to high temperatures, such as a torch flame, it decomposes. During decomposition it releases irritating and toxic gases (as described in the MSDS sheet from the manufacturer). Decomposition products are hydrofluoric acid, carbon dioxide and water.
- Do not allow any portion of the charged air conditioning system to become too hot. The pressure in an air conditioning system rises as the temperature rises and temperatures of approximately 85°C (185°F) can be dangerous.
- Allow the engine to cool sufficiently prior to carrying out maintenance or serious burns and injury can occur.

⚠ CAUTION: To avoid damaging the vehicle or A/C components, the following precautions must be observed:

- The A/C refrigerant of all vehicles must be identified and analyzed prior to refrigerant charging. Failure to do so can contaminate the shop bulk refrigerant and other vehicles.
- Do not add R-12 refrigerant to an A/C system that requires the use of R-134a refrigerant. These two types of refrigerant must never be mixed. Doing so can damage the A/C system.
- Charge the A/C system with the engine running. Use the low-pressure side of the A/C system when charging to prevent refrigerant slugging from damaging the A/C compressor.
- Use only R-134a refrigerant. Due to environmental concerns, when the air conditioning system is drained, the refrigerant must be collected using refrigerant recovery/recycling equipment. Federal law REQUIRES that R-134a be recovered into appropriate recovery equipment and the process be conducted by qualified technicians who have been certified by an approved organization, such as MACS, ASI, etc. Use of a recovery machine dedicated to R-134a is necessary to reduce the possibility of oil and refrigerant incompatibility concerns. Refer to the instructions provided by the equipment manufacturer when removing refrigerant from or charging the air conditioning system.
- Refrigerant R-134a must not be mixed with air for leak testing or used with air for any other purpose above atmospheric pressure. R-134a is combustible when mixed with high concentrations of air and higher pressures.
- A number of manufacturers are producing refrigerant products that are described as direct substitutes for refrigerant R-134a. The use of any unauthorized substitute refrigerant can severely damage the A/C components. If repair is required, use only new or recycled refrigerant R-134a.

⚠ CAUTION: To avoid contamination of the A/C system:

- Never open or loosen a connection before discharging the system.
- When loosening a connection, if any residual pressure is evident, allow it to leak out before opening the fitting.
- Before charging, evacuate a system that has been opened to install a new component or a system that has discharged through leakage.
- Seal open fittings with a cap or plug immediately after disconnecting a component from the system.
- Clean the outside of the fittings thoroughly before disconnecting a component from the system.
- Do not remove the sealing caps from a new component until ready to install.
- Refrigerant oil will absorb moisture from the atmosphere if left uncapped. Do not open an oil container until ready to use, and install the cap immediately after using. Store the oil in a clean, moisture-free container.
- Install a new O-ring seal before connecting an open fitting. Coat the fitting and the O-ring seal with refrigerant oil before connecting.
- When installing a refrigerant line, avoid sharp bends. Position the line away from the exhaust or any sharp edges that can chafe the line.
- Tighten threaded fittings only to specifications. The steel and aluminum fittings used in the refrigerant system will not tolerate overtightening.
- When disconnecting a fitting, use a wrench on both halves of the fitting to prevent twisting of the refrigerant lines or tubes.
- Do not open a refrigerant system or uncap a new component unless it is as close as possible to room temperature. This will prevent condensation from forming inside a component that is cooler than the surrounding air.

The electronic automatic temperature control system maintains the selected vehicle interior temperature by heating and/or cooling the air.

- During A/C operation the system also reduces the relative humidity of the air.
- The driver may override the automatic mode of operation.

Principles of Operation

There are four main principles involved with the basic theory of operation:

- heat transfer
- latent heat of vaporization
- relative humidity
- effect of pressure on boiling or condensation

Heat Transfer

If two substances of different temperature are placed near each other, the heat in the warmer substance will transfer to the colder substance.

Latent Heat of Vaporization

When a liquid boils (converts to gas) it absorbs heat without raising the temperature of the resulting gas. When the gas condenses (converts back to a liquid), it gives off heat without lowering the temperature of the resulting liquid.

Relative Humidity

The amount of moisture (water vapor content) that the air can hold is directly related to the air temperature.

The more heat there is in the air, the more moisture the air can hold. The lower the moisture content in the air, the more comfortable you feel. Removing moisture from the air lowers its relative humidity and improves personal comfort.

Effects of Pressure on Boiling or Condensation

As the pressure is increased on a liquid, the temperature at which the liquid boils (converts to gas) also increases. Conversely, when the pressure on a liquid is reduced, its boiling point is also reduced. When in the gas state, an increase in pressure causes an increase in temperature, while a decrease in pressure will decrease the temperature of the gas.

The Refrigerant Cycle

During stabilized conditions (air conditioning system shutdown), the refrigerant is in a vaporized state and pressures are equal throughout the system. When the A/C compressor is in operation it increases pressure on the refrigerant vapor, raising its temperature. The high-pressure and high-temperature vapor is then released into the top of the A/C condenser core.

The A/C condenser, being close to ambient temperature, causes the refrigerant vapor to condense into a liquid when heat is removed from the refrigerant by ambient air passing over the fins and tubing. The now liquid refrigerant, still at high pressure, exits from the bottom of the A/C condenser and enters the inlet side of the A/C receiver/drier. The receiver/drier is designed to remove moisture from the refrigerant.

The outlet of the receiver/drier is connected to the thermostatic expansion valve (TXV). The TXV provides the orifice which is the restriction in the refrigerant system and separates the high and low pressure sides of the A/C system. As the liquid refrigerant passes across this restriction, its pressure and boiling point are reduced.

The liquid refrigerant is now at its lowest pressure and temperature. As it passes through the A/C evaporator, it absorbs heat from the airflow passing over the plate/fin sections of the A/C evaporator. This addition of heat causes the refrigerant to boil (convert to gas). The now cooler air can no longer support the same humidity level of the warmer air and this excess moisture condenses on the exterior of the evaporator coils and fins and drains outside the vehicle.

The refrigerant cycle is now repeated with the A/C compressor again increasing the pressure and temperature of the refrigerant.

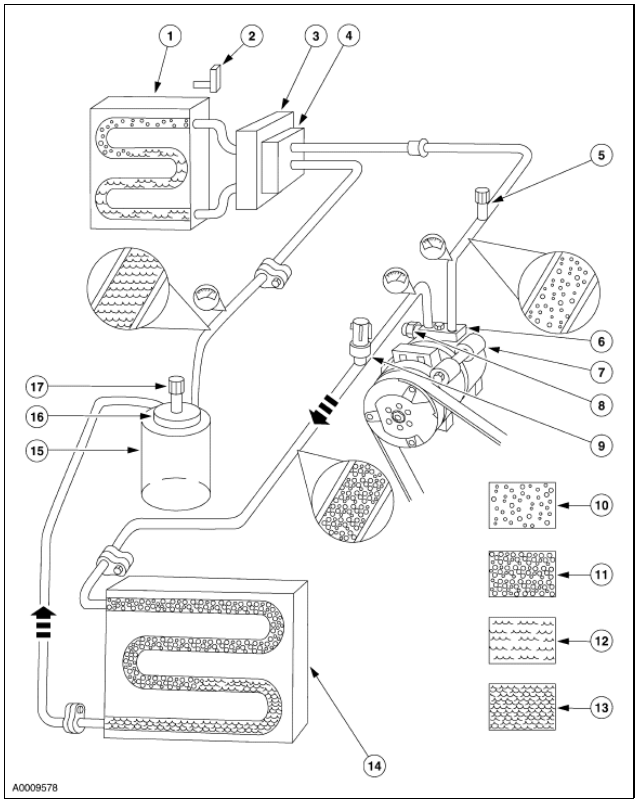
A thermistor which monitors the temperature of the air that has passed through the evaporator core controls A/C clutch cycling. If the temperature of the evaporator core discharge air is low enough to cause the condensed water vapor to freeze, the A/C clutch is disengaged by the vehicle powertrain control module (PCM).

The high-side line pressure is also monitored so that A/C compressor operation will be interrupted if the system pressure becomes too high or is determined to be too low (low charge condition).

The A/C compressor thermal protection switch will interrupt compressor operation if the compressor housing exceeds temperature limits.

The A/C compressor relief valve will open and vent refrigerant to relieve unusually high system pressure.

Clutch Cycling Thermostatic Expansion Valve Type Refrigerant System



Item	Part Number	Description
1	19860	A/C evaporator core
2	19C734	A/C evaporator core outlet temperature thermistor
3	19849	Thermostatic expansion valve
4	19835	Manifold and tube assembly thermostatic expansion valve
5	19D701	A/C charge valve port (low side)
6	19D734	Manifold and tube assembly A/C compressor
7	19703	A/C compressor
8	19D644	A/C pressure relief valve
9	19D594	A/C pressure transducer
10		Low pressure vapor
11		High pressure vapor
12		Low pressure liquid
13		High pressure liquid
14	19712	A/C condenser core
15	19959	A/C receiver/drier
16	19835	Manifold and tube assembly receiver/drier
17	19D701	A/C charge valve port (high side)

Dual Automatic Temperature Control (DATC) Module Description

The DATC system automatically maintains a selected temperature for vehicle interior comfort and regulates the volume of airflow between the instrument panel registers, floor ducts, windshield defroster nozzle, and side window demisters. The system will automatically select between fresh and recirculated air with an optional manual override. The DATC system will also include a manual A/C override, blower speed override,

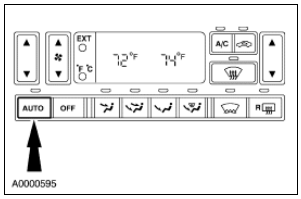
and airflow direction overrides.

The dual temperature zone feature provides the driver and the front seat passenger with their own independent temperature set points. The DATC system provides both the driver and front seat passenger with their selected temperature for interior comfort. In situations where the difference between the driver and the front seat passenger set points are very large, the DATC will tend to favor the driver's setting and make the front seat passenger as comfortable as possible.

The driver and front seat passenger will not have independent air distribution mode or fan controls so the system is dual temperature only. In some cases the passenger temperature set point may influence the air distribution mode or blower speed in automatic mode.

System Air Flow

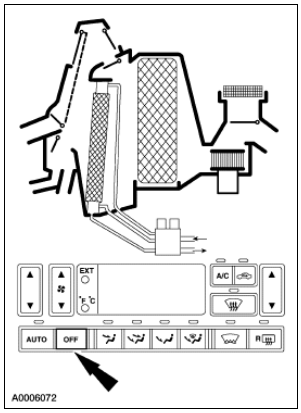
AUTO



When AUTO is selected:

- The temperature control setting(s) are manually set to the desired setting(s).
- The air inlet door actuator is automatically controlled by the DATC module, based on the temperature setting(s), but can be manually overridden by selecting the recirculation button.
- The panel door, floor door, defrost door and cold air bypass door actuators are automatically controlled by the DATC module based on the temperature setting(s), but can be manually overridden by selecting any of the air distribution buttons.
- The dual coolant control valve is automatically controlled by the DATC module based on the temperature setting(s).
- The A/C compressor is automatically controlled by the DATC module based on the temperature setting(s), but can be manually overridden by selecting the A/C button. The A/C compressor will not operate if the outside temperature is lower than approximately 2°C (35°F).
- The blower motor is on. The blower motor speed is automatically controlled by the DATC module based on the temperature setting(s), but can be manually overridden by adjusting the blower speed rocker button.

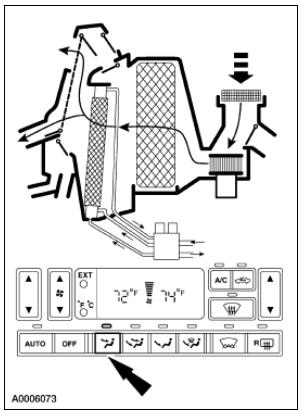
OFF



When OFF is selected:

- The air inlet door actuator positions the air inlet door to close off outside air from entering the passenger compartment.
- The floor door actuator positions the floor door in the open position, and the panel door actuator, defrost door actuator, and cold air bypass door actuator position the panel door, defrost door, and cold air bypass door in the closed positions. This closes off airflow to the defrost duct, the side window demisters, the floor duct and the instrument panel A/C registers.
- The dual coolant control valve is in the closed position, preventing the flow of hot coolant to the heater core.
- The blower motor is off.

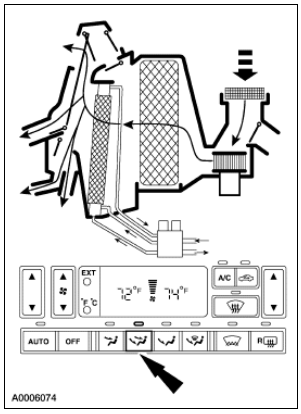
PANEL



When PANEL is selected:

- The Recirc request button is enabled. If the Recirc request button is selected (indicator on), the air inlet door actuator positions the air inlet door to close off outside air from entering the passenger compartment. If the Recirc request button is not selected (indicator off), the air inlet door actuator positions the air inlet door to admit only outside air into the passenger compartment.
- The panel door actuator positions the panel door in the open position and the floor door and defrost door actuators position the floor door and defrost door in the closed position, directing airflow to the instrument panel A/C registers. The cold air bypass door actuator is automatically controlled by the DATC module based on the temperature setting(s).
- The dual coolant control valve is automatically controlled by the DATC module based on the temperature setting(s).
- The A/C request button is enabled. When the A/C request button is selected (indicator on), the A/C compressor will operate if the outside air temperature is above approximately 2°C (35°F). When the A/C request button is not selected (indicator off), the A/C compressor will not operate and the air cannot be cooled below the outside temperature.
- The blower motor is on.

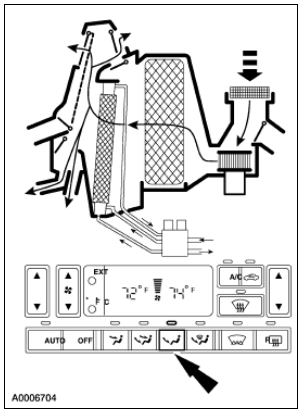
PANEL/FLOOR



When PANEL/FLOOR is selected:

- The Recirc request button is enabled. If the Recirc request button is selected (indicator on), the air inlet door actuator positions the air inlet door as to close off outside air from entering the passenger compartment. If the Recirc request button is not selected (indicator off), the air inlet door actuator positions the air inlet door to admit only outside air into the passenger compartment.
- The panel door and floor door actuators position the panel door and floor door in the open position and the defrost door actuator positions the defrost door in the closed position, directing airflow to the instrument panel A/C registers and the floor duct. The cold air bypass door actuator is automatically controlled by the DATC module based on the temperature setting(s).
- The dual coolant control valve is automatically controlled by the DATC module based on the temperature setting(s).
- The A/C request button is enabled. When the A/C request button is selected (indicator on), the A/C compressor will operate if the outside air temperature is above approximately 2°C (35°F). When the A/C request button is not selected (indicator off), the A/C compressor will not operate and the air cannot be cooled below the outside temperature.
- The blower motor is on.

FLOOR



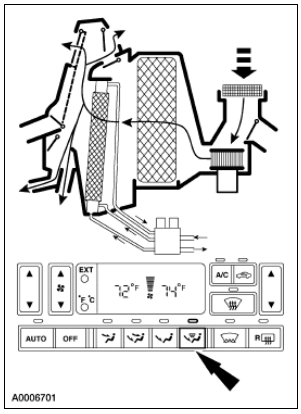
When FLOOR is selected:

- The Recirc request button is enabled. If the Recirc request button is selected (indicator on), the air inlet door actuator positions the air inlet door to close off outside air from entering the passenger compartment. If the Recirc request button is not selected (indicator off), the air inlet door actuator positions the air inlet door as to admit only outside air into the passenger compartment. The DATC will automatically revert to the outside air position after approximately 1 to 4 minutes to prevent window fogging.
- The floor door actuator positions the floor door in the open position and the panel door and defrost door actuators position the panel door and defrost door in the closed position, directing airflow to the

floor duct. A small amount of airflow from the outboard instrument panel A/C registers will be present. The cold air bypass door actuator is automatically controlled by the DATC module based on the temperature setting(s).

- The dual coolant control valve is automatically controlled by the DATC module based on the temperature settings.
- The A/C request button is enabled. When the A/C request button is selected (indicator on), the A/C compressor will operate if the outside air temperature is above approximately 2°C (35°F). When the A/C request button is not selected (indicator off), the A/C compressor will not operate and the air cannot be cooled below the outside temperature.
- The blower motor is on.

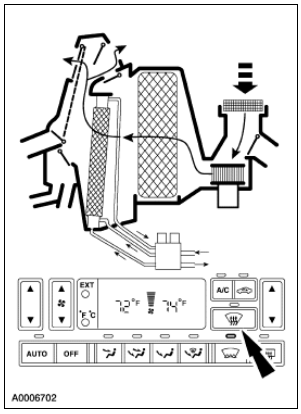
FLOOR/DEFROST



When FLOOR/DEFROST is selected:

- The Recirc request button is enabled. If the Recirc request button is selected (indicator on), the air inlet door actuator positions the air inlet door to close off outside air from entering the passenger compartment. If the Recirc request button is not selected (indicator off), the air inlet door actuator positions the air inlet door as to admit only outside air into the passenger compartment. The DATC will automatically revert to the outside air position after approximately 1 to 4 minutes to prevent window fogging.
- The floor door and defrost door actuators position the floor door and defrost door in the open position and the panel door actuator positions the panel door in the closed position, directing airflow to the floor duct, the windshield defroster ducts, and the side window demisters. A small amount of airflow from the outboard instrument panel A/C registers will be present. The cold air bypass door actuator is automatically controlled by the DATC module based on the temperature setting(s).
- The dual coolant control valve is automatically controlled by the DATC module based on the temperature settings.
- The A/C request button is enabled. When the A/C request button is selected (indicator on), the A/C compressor will operate if the outside air temperature is above approximately 2°C (35°F). When the A/C request button is not selected (indicator off), the A/C compressor will not operate and the air cannot be cooled below the outside temperature.
- The blower motor is on.

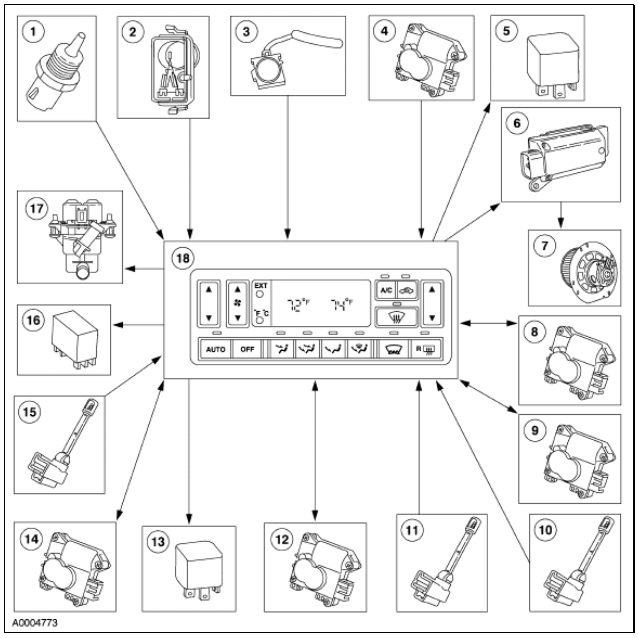
DEFROST



When DEFROST is selected:

- The Recirc request button is disabled. The air inlet door actuator positions the air inlet door to admit only outside air into the passenger compartment.
- The defrost door actuator positions the defrost door in the open position and the panel door, floor door, and cold air bypass door actuators position the panel door, floor door, and cold air bypass door in the closed position, directing airflow to the windshield defroster ducts and the side window demisters. A small amount of airflow from the outboard instrument panel A/C registers will be present.
- The dual coolant control valve is automatically controlled by the DATC module based on the temperature settings.
- The A/C request button is disabled. To reduce fogging, the A/C compressor will operate if the outside air temperature is above approximately 2°C (35°F).
- The blower motor is on.

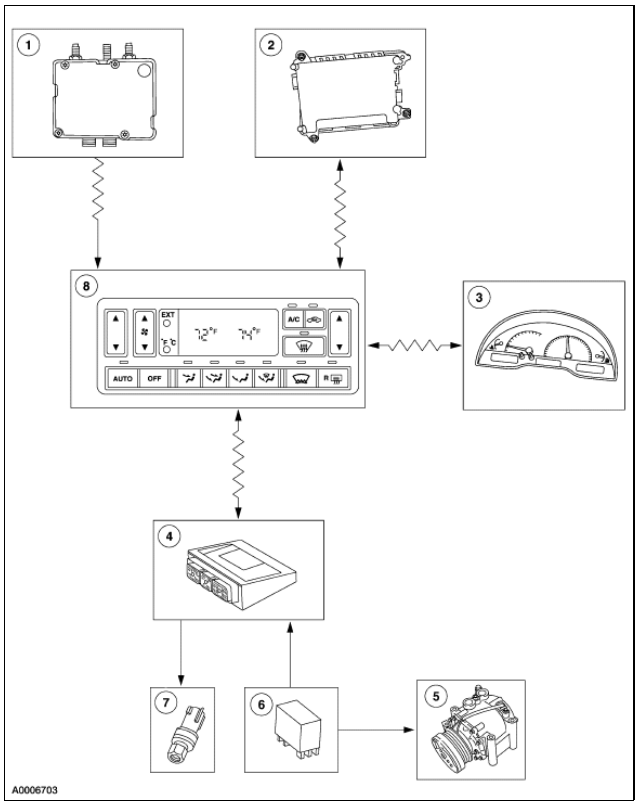
Climate Control System Electrical Components Directly Linked to DATC Module



Item	Part Number	Description
1	12A647	Ambient air temperature sensor
2	19C734	In-vehicle temperature control sensor
3	19E663	Dual sunload sensor
4	19E616	Panel door actuator

5	14N089	Blower motor ignition relay
6	19E624	Blower motor speed control
7	19805	Blower motor
7	18504	Blower wheel (not serviced with motor)
8	19E616	Air inlet door actuator
9	19E616	Cold air bypass door actuator
10	19C734	Passenger air discharge temperature sensor
11	19C734	Evaporator discharge air temperature sensor
12	19E616	Floor door actuator
13	14N089	Heated wiper park relay
14	19E616	Defrost door actuator
15	19C734	Driver air discharge temperature sensor
16	14N089	Electric water pump relay
17	18495	Dual coolant control valve
18	19980	Dual automatic temperature control module

Climate Control System Components J1850 Communications Network (SCP) Linked



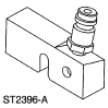
Item	Part Number	Description
1	2C219	ABS module
2	24994	Rear electronic module (REM)
3	10849	Instrument cluster module
4	12A696	Powertrain control module
5	19703	A/C compressor
6	14N089	A/C clutch relay
7	19D594	A/C pressure transducer

8	19980	Dual automatic temperature control module

Climate Control System

Refer to Wiring Diagrams Cell 55 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-224, New Generation STAR (NGS) Tester 418-F052, or equivalent scan tool
 ST1137-A	Fluke 77 III Automotive Meter 105-R0056 or equivalent
 ST1928-A	R-134a Manifold Gauge Set 176-R032A or equivalent
 ST1501-A	A/C Pressure Test Adapter 412-093 (T94P-19623-E)
 ST1252-A	Set, A/C Fittings 412-DS028 (014-00333, D93L-19703B) or equivalent
 ST2351-A	Refrigerant Leak Detector 216-00001 or equivalent
 ST1474-A	Pressure Test Kit 014-R1072 or equivalent
 ST2396-A	Vacuum Check Fitting, TXV 412 129 or equivalent

Inspection and Verification

1. Verify the customer's concern by operating the climate control system to duplicate the condition.
2. Inspect to determine if one of the following mechanical or electrical concerns apply:

   Visual Inspection Chart

Mechanical	Electrical
• Loose, missing or damaged A/C compressor drive belt • Loose or disconnected A/C clutch	• Fuse(s) • Blower motor inoperative • A/C compressor inoperative • Circuit short/open.

• Broken or leaking refrigerant lines • Obstructed in-vehicle temperature sensor • Disconnected in-vehicle temperature aspirator hose • A/C registers are not working (open/close) • Front floor ducts not in place • Incorrectly installed in-vehicle temperature sensor • Incorrectly installed ambient air temperature sensor	• Disconnected, loose fitting, or incorrectly installed electrical connectors and pins • Cooling fan inoperative • Relays not functional or not installed

3. As pinpoint tests and measurements are being performed, be sure to inspect for any disconnected, loose fitting, or i0ncorrectly installed component, module and in-line electrical connectors and pins.

4. If the inspection reveals obvious concerns that can be readily identified, repair as necessary.

5. If the concern remains after the inspection, connect the scan tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the scan tool menu. If the vehicle selection cannot be entered:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.
   - check that the battery voltage is greater than 9V.

If the scan tool still does not allow the vehicle selection to be entered, refer to the scan tool manual.

6. Carry out the Data Link Diagnostic Test using the scan tool. If the scan tool responds with:
   - CKT 914 and CKT 915 = ALL MODULE NO RESPONSE/NOT EQUIPPED, go to Module Communication Network Diagnostics in Section 418-00 to diagnose the network concern.
   - If the powertrain control module (PCM) is not listed for a communication concern, turn the A/C controls to OFF and execute the self-test diagnostics for the PCM.
   - If the DATC module is not listed for a communication concern, execute the self-test diagnostics for the DATC module.

7. If any PCM or DATC DTCs are retrieved, and are related to the concern, go to the Powertrain Control Module Diagnostic Trouble Code (DTC) Index or the Dual Automatic Temperature Control (DATC) Module Diagnostic Trouble Code (DTC) Index in this section to continue the diagnostics.

8. If no DTCs related to the concern are retrieved, GO to Symptom Chart to continue the diagnostics.

9. If the DATC module cannot be accessed by the scan tool, Go To Pinpoint Test A .

Dual Electronic Automatic Temperature Control (DATC) Module Diagnostic Trouble Codes DTCs

Using a scan tool or front panel diagnostics to check for DATC DTCs:

1. Check continuous DTCs.

2. Run DATC self-test. Refer to Front Panel DATC Self-Test (On-demand Diagnostic Trouble Codes DTCs).

General information:

- If the DTC is continuous only and does not appear in the self-test, this indicates an intermittent fault condition, such as a poor wiring connection or a loose terminal. If the DATC does not appear after running the self-test it may also indicate that the DTC may no longer exist.
- If the DTC is continuous and appears in the self-test, this indicates a hard fault. A hard fault suggests a permanent wiring failure, disconnected connector or component failure.

Front Panel DATC Module Self-Test (On-demand Diagnostic Trouble Codes DTCs)

On-demand DTCs are those that are reported by an ECU when a failure is detected while executing a diagnostic test. For the DATC module this means that all faults (hard) that occur while the module is conducting a self-test shall be reported as an on-demand DTC.

- The DATC module self-test will not detect concerns associated with data link messages such as engine coolant temperature or vehicle speed signals. The scan tool must be used to retrieve these concerns.
- The vehicle interior temperature should be between 0-32°C (32-90°F) when carrying out the self-test. If the temperatures are not within the specified ranges, false temperature sensor DTCs may be displayed.

The DATC module self-test through the front panel display:

- can be initiated at any time. Normal operation of the system stops when the self-test is activated.
- is entered by pressing the OFF and FLOOR buttons simultaneously and then pressing the AUTO button within two seconds. The display will show counts of 1 to 25 in the center of the display window. Record all DTCs displayed.
- concludes by reporting all on-demand DTCs. Follow the diagnostics procedure given under ACTION in the DTC index for each DTC given.
- reports individual on-demand DTCs as four-digit DTCs (less the alpha character).
- will calibrate all the mode doors and check all analog inputs. The DATC module will only report on-demand (hard) faults that occurred while the DATC module was conducting its self-test.
- will light all control panel display segments if no faults are detected.
- will report individual on-demand DTCs without the °C symbol lit.

To exit the self-test, press any button. This will clear all on-demand codes from the DATC module memory. If no button is pushed DTCs will continue to be displayed.

Upon exit from the self-test the DATC module returns to operational status. The DATC module executes a hard (cold boot) reset which places the DATC system in the OFF mode.

If a condition exists but no DTCs appear during the self-test, GO to Symptom Chart Condition: The DATC System Is Inoperative, Intermittent or Incorrect Operation.

Always exit the self-test before powering the system down (system turned OFF).

Front Panel DATC Module Display Retrieve Continuous Diagnostic Trouble Codes (DTCs)

Continuous DTCs are fault codes recorded by the DATC module which have occurred during normal operation. For the DATC module this means that all faults (intermittent or hard) that occur while the module is in an operational state shall be reported as a continuous DTC.

- To retrieve continuous DTCs, press the OFF and PANEL buttons simultaneously, followed by pressing the AUTO button within two seconds.

- The DATC module will report all continuous DTCs to the vacuum fluorescent (VF) display.
- The DATC module will not carry out a self-test; it will only display continuous faults codes which are stored in memory.
- All VF display segments will light if no faults are detected.
- Individual continuous DTCs will be reported with the °C symbol lit.
- DTCs shall be reported as a four-digit DTC (less the alpha character).
- Pressing the front defrost button will exit the retrieve continuous DTCs mode and clear all continuous DTCs from DATC module memory.
- Pressing any other button (other than DEFROST) will exit the retrieve continuous DTCs mode and maintain all continuous DTCs in DATC module memory.
- Upon exit from the retrieve continuous DTCs mode the DATC module returns to operational status. The DATC module executes a hard (cold boot) reset which places the DATC system in the OFF mode.

Diagnostic Trouble Code Index

Powertrain Control Module (PCM) Diagnostic Trouble Code (DTC) Index

DTC	Description	Action
P1460	WOT A/C cutout internal driver malfunction	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1461	A/C pressure sensor circuit high input	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1462	A/C pressure sensor circuit low input	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1463	A/C pressure sensor insufficient pressure variation	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
P1469	Low A/C cycling period	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.
P1474	Low speed fan internal driver failure	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.
P1479	High speed fan internal driver failure	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.
P1464	A/C demand out of self-test range	REFER to thePowertrain Control/Emissions Diagnosis (PC/ED) manual.

Dual Electronic Automatic Temperature Control (DATC) Module Diagnostic Trouble Code (DTC) Index

DTC	Run-Time (Intermittent) Faults or Self-Test (Hard) Faults	Description	Action to Take
B1242	1242	Recirculation door actuator circuit failure	Go To Pinpoint Test C .
B1251	1251	In-vehicle temperature sensor circuit open	Go To Pinpoint Test D .
B1253	1253	In-vehicle temperature sensor circuit short to ground	Go To Pinpoint Test D .
B1255	1255	Ambient air temperature sensor open	Go To Pinpoint Test F .

B1257	1257	Ambient air temperature sensor short to ground	Go To Pinpoint Test F .
B1259	1259	A/C solar radiation sensor open circuit	Go To Pinpoint Test G .
B1261	1261	A/C solar radiation sensor circuit short to ground	Go To Pinpoint Test G .
B1262	1262	Defrost door actuator circuit failure	Go To Pinpoint Test C .
B1263	1263	Panel door actuator circuit failure	Go To Pinpoint Test C .
B1264	1264	Floor door actuator circuit failure	Go To Pinpoint Test C .
B1265	1265	Cold air bypass door actuator circuit failure	Go To Pinpoint Test C .
B1342	1342	ECU defective	INSTALL a new DATC module.
B1676	1676	Battery voltage out of range	REFER to Section 414-00 .
B1946	1946	Evaporator discharge temperature sensor open circuit	Go To Pinpoint Test E .
B1947	1947	Evaporator discharge temperature sensor circuit short to ground	Go To Pinpoint Test E .
B1966	1966	Driver heater core discharge temperature sensor open circuit	Go To Pinpoint Test E .
B1967	1967	Driver heater core discharge temperature sensor short circuit	Go To Pinpoint Test E .
B2428	2428	Passenger heater core discharge temperature sensor open circuit	Go To Pinpoint Test E .
B2429	2429	Passenger heater core discharge temperature sensor short circuit	Go To Pinpoint Test E .
B2477	2477	Module configuration failure	RECONFIGURE the DATC module. REFER to Section 418-01 .
U1041	5041	SCP invalid or missing data for function read vehicle speed	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1073	5073	SCP invalid or missing data for engine coolant	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1027	5027	SCP invalid or missing data for engine rpm	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1178	5178	SCP invalid or missing data for voice command	This code will only appear if the vehicle is equipped with voice command.
U1222	5222	SCP invalid or missing data	REFER to Section 417-02 .

		for interior lamps	

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE DUAL AUTOMATIC TEMPERATURE CONTROL (DATC) MODULE

PINPOINT TEST B: THE DATC SYSTEM IS INOPERATIVE, INTERMITTENT OR INCORRECT OPERATION

PINPOINT TEST C: INCORRECT/ERRATIC DIRECTION OF AIRFLOW FROM OUTLETS

PINPOINT TEST D: DTC B1251: DTC B1253 IN-VEHICLE TEMPERATURE SENSOR NOT OPERATING CORRECTLY

PINPOINT TEST E: EVAPORATOR OR HEATER CORE DISCHARGE AIR TEMPERATURE SENSORS NOT OPERATING CORRECTLY

PINPOINT TEST F: DTC B1255 OR B1257 AMBIENT AIR TEMPERATURE SENSOR CIRCUIT OPEN OR SHORT TO GROUND

PINPOINT TEST G: DTC B1259 OR B1261 SOLAR RADIATION SENSOR CIRCUIT OPEN OR SHORT TO GROUND

PINPOINT TEST H: INSUFFICIENT, ERRATIC, OR NO HEAT

PINPOINT TEST I: INSUFFICIENT HEAT DURING ENGINE IDLE 3.9L ENGINE

PINPOINT TEST J: FULL HEAT ONLY IN ALL MODES

PINPOINT TEST K: THE DUAL TEMPERATURE CONTROL IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

PINPOINT TEST L: THE AIR CONDITIONING (A/C) IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

PINPOINT TEST M: THE AIR CONDITIONING (A/C) IS ALWAYS ON

PINPOINT TEST N: THE BLOWER MOTOR IS INOPERATIVE

PINPOINT TEST O: THE BLOWER MOTOR DOES NOT OPERATE CORRECTLY

PINPOINT TEST P: THE TEMPERATURE SET POINT DOES NOT REPEAT AFTER TURNING THE IGNITION SWITCH OFF

PINPOINT TEST Q: THE EXTERIOR TEMPERATURE DISPLAY DOES NOT FUNCTION CORRECTLY

Component Tests

Heater Core

⚠ WARNING: Carbon monoxide is colorless, odorless and dangerous. If it is necessary to operate the engine with the vehicle in a closed area such as a garage, always use an exhaust collector to vent the exhaust gases outside the closed area.

1. **NOTE:** Testing of returned heater cores reveals that a large percentage of heater cores are good and did not require the installation of a new heater core. If a heater core leak is suspected, the heater core must be tested by following the plugged heater core component test before the heater core pressure test. Carry out a system inspection by checking the heater system thoroughly as follows:

   Inspect for evidence of coolant leakage at the heater hose to heater core attachments. A coolant leak in the heater hose could follow the heater core tube to the heater core and appear as a leak in the heater core.

2. **NOTE:** Spring-type clamps are installed as original equipment. Installation and overtightening of non-specification clamps can cause leakage at the heater hose connection and damage the heater core.

   Check the integrity of the heater hose clamps.

Heater Core Plugged

⚠ WARNING: The heater core inlet hose will become too hot to handle if the system is working correctly.

1. Check to see that the engine coolant is at the correct level.

2. Start the engine and turn on the heater.

3. When the engine coolant reaches operating temperature, feel the heater core inlet and outlet hoses to see if they are hot.

4. If the outlet only is not hot:
   - the heater core may have an air pocket.
   - the heater core may be plugged.

5. If the inlet only is not hot:
   - the thermostat may not be working correctly.
   - the coolant control valve may not be working correctly.

Heater Core Pressure Test

Use the Pressure Test Kit to carry out the pressure test.

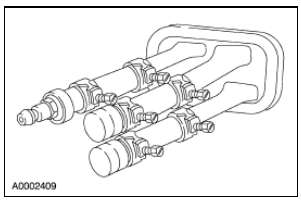
1. **NOTE:** Due to space limitations, a bench test may be necessary for pressure testing.

   Drain the coolant from the cooling system.

2. Disconnect the heater hoses from the heater core. For additional information, refer to Section 412-02 .

3. Install a short piece of heater hose, approximately 101 mm (4 inches) long on each heater core tube.

4. Fill the heater core and heater hoses with water and install the two plugs BT-7422-B and the adapter BT-7422-A from the Pressure Test Kit. Secure the heater hoses, plug and adapter with hose clamps.



5. Attach the pump and gauge assembly from the Pressure Test Kit to the adapter.

6. Close the bleed valve at the base of the gauge. Pump 241 kPa (35 psi) of air pressure into the heater core.

7. Observe the pressure gauge for a minimum of three minutes.

8. If the pressure drops, check the heater hose connections to the core tubes for leaks. If the heater hoses do not leak, remove the heater core from the vehicle and carry out the bench test.

Heater Core Bench Test

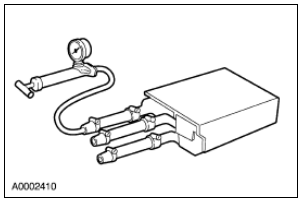
1. Remove the heater core from the vehicle. For additional information, refer to Section 412-02 .

2. Drain all of the coolant from the heater core.

3. Connect the 101 mm (4 inch) test heater hoses with plug and adapter to the core tubes. Then connect the Pressure Test Kit to the adapter.

4. Apply 241 kPa (35 psi) of air pressure to the heater core. Submerge the heater core in water.

5. If a leak is observed, install a new heater core.



Condenser Core On-Vehicle Leak Test

1. Discharge and recover the refrigerant. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

2. Disconnect the condenser core from the A/C system. For additional information, refer to Section 412-03 .

3. Clean the manifold fittings.

4. Connect the appropriate test fittings from the Set, A/C Fittings to the condenser core tube connections.

5. Connect the Vacuum Check Fitting, TXV to the thermostatic expansion valve.

6. **NOTE:** The automatic shut-off valves on some gauge set hoses do not open when connected to the test fittings. If available, use hoses without shut-off valves. If hoses with shut-off valves are used, make sure the valve opens when attached to the test fittings or install an adapter which will activate the valve. The test is not valid if the shut-off valve does not open.

   Connect the red and blue hoses from the R-134a Manifold Gauge Set to the test fittings on the evaporator core or condenser core. Connect the yellow hose to a known good vacuum pump.

7. Open both gauge set valves and start the vacuum pump. Allow the vacuum pump to operate for a minimum of 45 minutes after the gauge set low pressure gauge indicates 101 kPa (30 in-Hg). The 45 minute evacuation is necessary to remove any refrigerant from oil left in the condenser core. If the refrigerant is not completely removed from the oil, outgassing will degrade the vacuum and appear as a refrigerant leak.

8. If the low pressure gauge reading will not drop to 101 kPa (30 in-Hg) when the valves on the gauge and manifold set are open and the vacuum pump is operating, close the gauge set valves and observe the low pressure gauge. If the pressure rises rapidly to zero, a large leak is indicated. Recheck the test fitting connections and gauge set connections before installing a new condenser core.

9. After evacuating for 45 minutes, close the gauge set valves and stop the vacuum pump. Observe the low pressure gauge; it should remain at the 101 kPa (30 in-Hg) mark.
   - If the low pressure gauge reading rises 34 or more kPa (10 or more in-Hg) of vacuum from the 101 kPa (30 in-Hg) position in 10 minutes, a leak is indicated.
   - If a very small leak is suspected, wait 30 minutes and observe the vacuum gauge.
   - If a small amount of vacuum is lost, operate the vacuum pump with gauge valves open for an additional 30 minutes to remove any remaining refrigerant from the oil in the condenser core. Then recheck for loss of vacuum.
   - If a very small leak is suspected, allow the system to sit overnight with vacuum applied and check for vacuum loss.

10. If the condenser core does leak, as verified by the above procedure, install a new condenser core. For additional information, refer to Section 412-03 .

A/C Compressor External Leak Test

1. Install the A/C Pressure Test Adapter on the port of the A/C compressor using the existing manifold retaining bolt.

2. Connect the high and low pressure lines of a manifold gauge set or a refrigerant recovery/recycling station such as the R-134a A/C service center to the corresponding fittings on the A/C Pressure Test

Adapter.

3. Attach the center hose of a manifold gauge set to a refrigerant container standing in an upright position.

4. Hand-rotate the compressor shaft 10 complete revolutions to distribute the oil inside the A/C compressor.

5. Open the low pressure gauge valve, the high pressure gauge valve and the valve on the refrigerant container to allow the refrigerant vapor to flow into the A/C compressor.

6. Using the Refrigerant Leak Detector, check for leaks at the compressor shaft.

7. If a shaft or external leak is found, install a new A/C compressor. For additional information, refer to Section 412-03 .

8. When the leak test is complete, recover the refrigerant from the compressor.

Air Conditioning (A/C) System Check Retail Procedure

NOTE: This Retail Procedure is not eligible for claiming on Ford paid repairs (warranty and ESP).

NOTE: The engine should be run at idle for 10 minutes with the air conditioning on and set to MAX A/C before carrying out this retail procedure.

NOTE: Read and follow all of the Warnings, Cautions and Notes at the beginning of this section before continuing.

Visual inspection

1. Open the hood and visually inspect the heating and air conditioning systems for the following:
   - Coolant reservoir for correct coolant level
   - Heater hoses for deterioration or loose connections
   - Radiator and condenser for debris or damaged fins restricting airflow, loose mounting or connections
   - Accessory drive belt(s) and cooling fan(s) for wear or physical damage
   - Refrigerant lines and connections for physical damage or loose connections
   - Compressor for physical damage or loose connections
   - Receiver/drier for physical damage or loose connections
   - Wiring and connectors for excessive wear, loose or damaged connections, or incorrect routing

A/C refrigerant analysis

2. Carry out air conditioning refrigerant analysis. For additional information, refer to Refrigerant Identification Testing in this section.
   - If the refrigerant fails the analysis, discontinue diagnosis and make recommendations for repairs.
   - If the refrigerant passes the analysis, carry out the air conditioning system check.

Air conditioning system check

3. Connect manifold gauge set or charging station with gauges to refrigerant system.
   - With the vehicle in park, parking brake set, thermometer installed in center panel vent, and air conditioning system on and set to FULL COOL, start the engine.
   - Record air refrigerant system pressures while running the engine at 1,500 rpm and allow engine to return to idle.
   - Operate the blower motor in all control positions and check for correct blower speed changes.
   - With the blower motor on HI, operate air discharge mode selector in all positions and check for correct airflow in each position.
   - Operate the temperature blend selector in all positions and check for correct change in discharge temperature. Check the air discharge temperature with the selector in the coolest position and the air conditioning on and set to FULL COOL to determine if the air discharge temperature is acceptable for the current ambient air temperature.
   - Carry out the DATC self-test (if applicable).
     If the refrigerant system pressures were low, carry out the refrigerant system leak test.

Refrigerant system leak test

4. Use either an ultraviolet (UV) or an electronic leak detector to check for leaks at all refrigerant lines, connections, and components.
   After all tests have been completed, report all findings and recommended repairs to your service advisor before carrying out further diagnostic procedures.

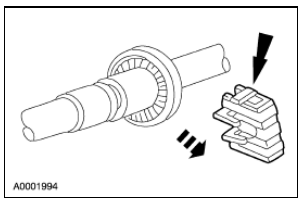
Spring Lock Coupling

Special Tool(s)

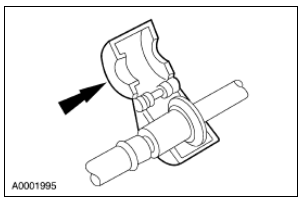
 ST2352-A	Remover, Refrigerant Coupling Spring 412-039 (T84L-19623-B)

Disconnect

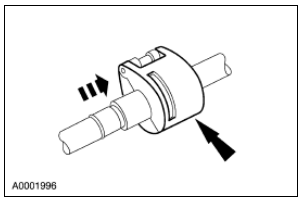
1. Remove the A/C tube lock coupling clip (19E746), if equipped.


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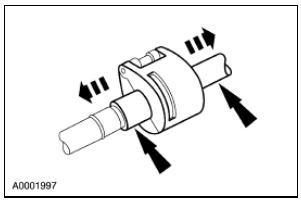
2. Fit the special tool to the spring lock coupling.


A0001995

3. Push the tool into the cage opening to release the female fitting from the A/C tube lock coupling spring (19E576).

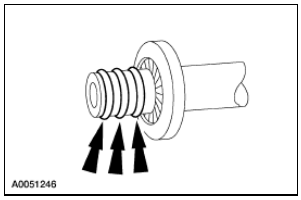

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4. Pull the spring lock coupling fittings apart.


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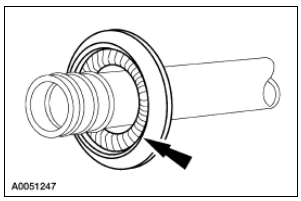
5. ⚠ **CAUTION: Do not use metal tools to remove the O-ring seals. They can cause axial scratches across the O-ring seal grooves, resulting in refrigerant leaks.**

   Remove the O-ring seals with a non-metallic tool.



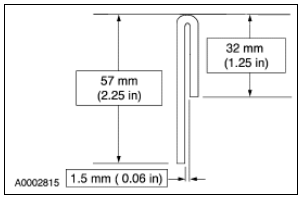
6. ⚠ **CAUTION: Do not use a screwdriver or similar tool to remove the A/C tube lock coupling spring; this can cause axial scratches across the O-ring seal grooves resulting in refrigerant leaks.**

   Remove the A/C tube lock coupling spring with a small hooked wire.



Cleaning

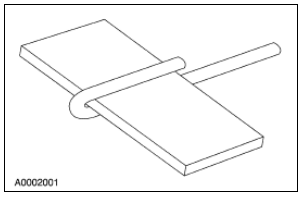
1. Fabricate a cleaning tool from a 1/8 inch diameter brazing rod.



2. Cut an abrasive pad from maroon colored 3M Scotch Brite® with the dimensions corresponding to the coupling size.

Coupling Size	Pad Size
3/8 inch	25 x 50 mm (1 x 2 inch)
1/2 inch	25 x 50 mm (1 x 2 inch)
5/8 inch	25 x 76 mm (1 x 3 inch)
3/4 inch	25 x 102 mm (1 x 4 inch)

3. Assemble the pad to the tool.

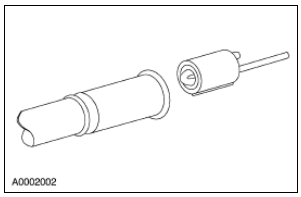


4. Coat the abrasive pad with PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent.

5. Roll the pad on the tool and install it in a variable speed drill motor.

6. ⚠ **CAUTION: Maintain low speed drill rotation when inserting or removing the cleaning tool to prevent axial scratches which may cause future leaks.**

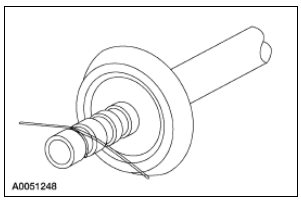
Polish for one minute at moderate speed (less than 1,500 rpm) or until the surface is clean and free of scratches or foreign material.



7. Clean the fitting with a lint-free cloth.

8. Inspect the surface for grooves or scratches. If grooves and scratches are still present, install a new component.

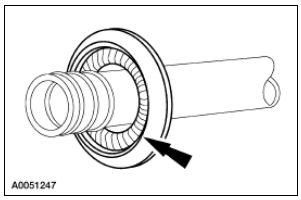
9. Clean the O-ring seal grooves with a 300 mm (12 inch) length of natural fiber string.
   - Loop the string around the grooves and pull the string back and forth.



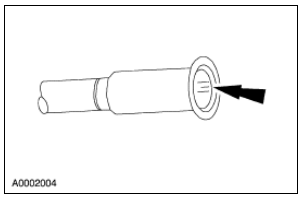
10. Remove any foreign material from the grooves with a lint-free cloth.

Connect

1. Install the A/C tube lock coupling spring.



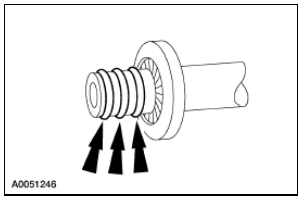
2. Lubricate the inside of the coupling with PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent.



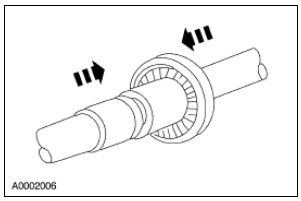
3. ⚠ **CAUTION: Use only the new O-ring seals. The use of any O-ring seals other than those specified in the Ford Master Parts Catalog may result in intermittent leakage during vehicle operation.**

   Install the O-ring seals.

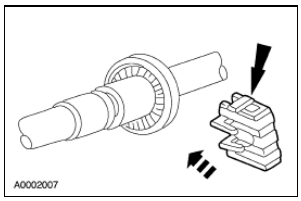
   - Lubricate the O-ring seals with PAG Refrigerant Compressor Oil (R-134a Systems) or equivalent.



4. Connect the spring lock coupling fittings with a twisting motion until the A/C tube lock coupling spring snaps over the flared end of the female fitting.



5. Install the A/C tube lock coupling clip.

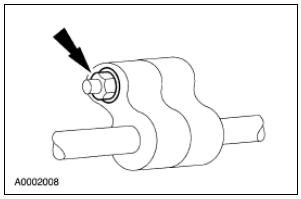


Air Conditioning Line (Peanut) Fitting

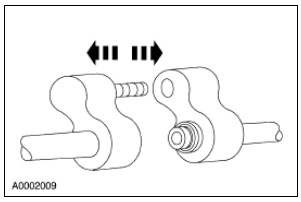
Disconnect

1. ⚠ **CAUTION: Support the female fitting with a wrench to prevent the tubes from twisting.**

   Remove the nut from the peanut fitting.

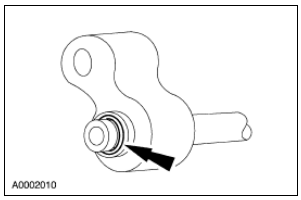


2. Pull the peanut fitting apart.



3. ⚠ **CAUTION: Do not use metal tools to remove the O-ring seal. They can cause axial scratches across the O-ring seal groove, resulting in refrigerant leaks.**

   Remove the O-ring seal with a non-metallic tool.

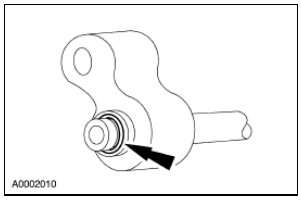


Connect

1. Clean all dirt or foreign material from the fittings.
2. ⚠ **CAUTION: Use only the new O-ring seals. The use of any O-ring seals other than those specified in the Ford Master Parts Catalog may result in intermittent leakage during vehicle operation.**

   Install the O-ring seal.

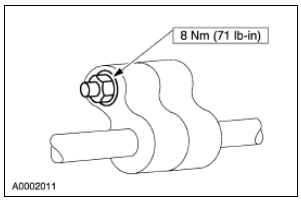
   - Lubricate the O-ring seal with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.



3. Lubricate the inside of the fittings with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.

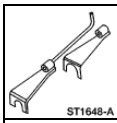
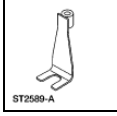
4. **NOTE:** When correctly assembled, the male and female fittings should be flush.

   Assemble the male and female fittings together.



Heater Hose Coupling

Special Tool(s)

 ST1648-A	Remover, Heater Hose Inlet Tube 412-042 (T85T-18539-AH)
 ST2589-A	Disconnect Tool, Heater Hose 412-127

Material

Item	Specification
MERPOL®	ESE-M99B144-B

Disconnect

⚠ CAUTION: Do not attempt to install a new bushing, spacer or O-rings in the heater hose coupling; damage to the heater hose coupling can result. If the heater hose coupling is the cause of a coolant leak, the affected heater hose must be replaced as an assembly.

1. **⚠ WARNING: The engine must be off, fully cool and the cooling system fully depressurized before attempting to disconnect any heater water hoses. Failure to comply with this warning can result in serious injury or burns from hot liquid escaping out of the engine cooling system.**

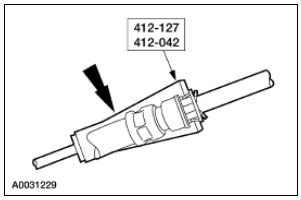
   Depressurize the engine cooling system.

2. Push the heater hose toward the tube to fully expose the locking tabs.

3. **NOTE:** When compressing the white coupling retainer with the special tool, the special tool must be perpendicular to and on the highest point of the coupling.

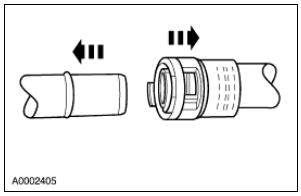
   NOTE: If the heater hose coupling is accessible, the retainer tabs can be compressed by hand to disconnect the heater hose.

   Push the special tool over the coupling retainer windows to compress the retainer locking tabs.

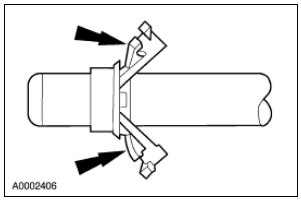


4. **NOTE:** A slight twisting motion while pulling on the heater water hose may be necessary to assist in the removal.

   Pull the heater hose away from the heater core tube.



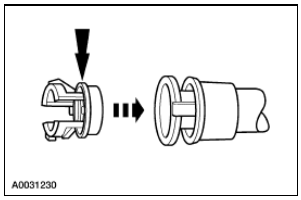
5. Spread the retainer tabs apart and slide the retainer off the tube.
    - Discard the retainer.



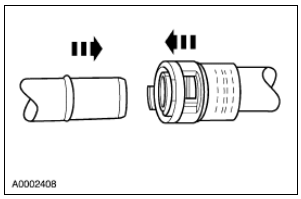
Connect

1. Clean the tubes and lubricate with coolant hose lubricant or plain water.

2. Install a new coupling retainer (18D434) into the heater hose coupling housing.



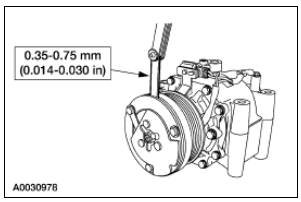
3. Push the heater hose coupling onto the tube.



4. Make sure the heater hose coupling is fully engaged by lightly pulling on the heater hose.

A/C Clutch Air Gap Adjustment

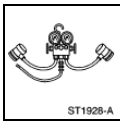
1. Check the A/C clutch air gap at three equally spaced places between the clutch hub and the A/C clutch pulley.



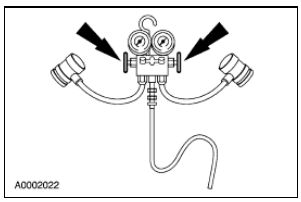
2. Remove the A/C clutch. Add or remove spacers between the A/C clutch and the compressor shaft until clearance is within specifications.

Manifold Gauge Set Connection

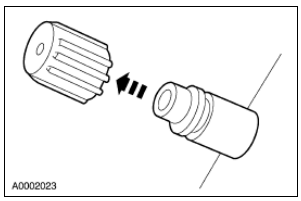
Special Tool(s)

 ST1928-A	R-134a Manifold Gauge Set 176-R032A or equivalent

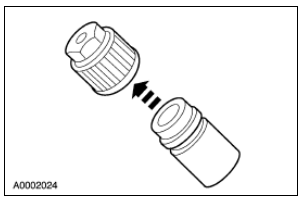
1. Turn both valves on the R-134a Manifold Gauge Set clockwise to close the low- and high-pressure hoses to the center manifold and center hose.


A0002022

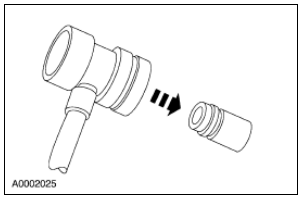
2. Remove the A/C charging valve cap (19D702) from the low-pressure service gauge port valve.


A0002023

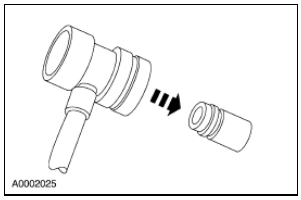
3. Remove the A/C charging valve cap from the high-pressure service gauge port valve.


A0002024

4. Connect the R-134a Manifold Gauge Set low-pressure hose and the R-134a low side quick disconnect to the low-pressure service gauge port valve.


A0002025

5. Connect the R-134a Manifold Gauge Set high-pressure hose and the R-134a high side quick disconnect to the high-pressure service gauge port valve.


A0002025

Electronic Leak Detection

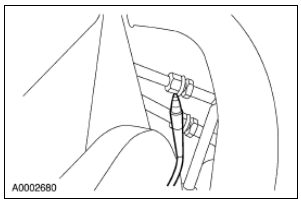
Special Tool(s)

 ST2351-A	H10PM Refrigerant Leak Detector With Battery 216-00001 or equivalent

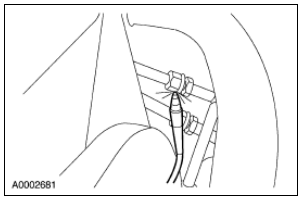
⚠ CAUTION: Good ventilation is necessary in the area where electronic A/C leak testing is to be carried out. If the surrounding air is contaminated with refrigerant gas, the leak detector will indicate this gas all the time. Odors from other chemicals such as antifreeze, diesel fuel, disc brake cleaner, or other cleaning solvents can cause the same problem. A fan, even in a well-ventilated area, is very helpful in removing small traces of contamination from the air that might affect the leak detector.

1. **NOTE:** The system pressure should be between 413-551 kPa (60-80 psi) at 24°C (75°F) with the engine off.

   Leak test the refrigerant system using the Refrigerant Leak Detector. Follow the instructions included with the leak detector for handling and operation techniques.

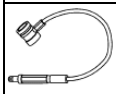
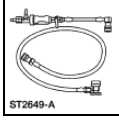


2. If a leak is found, discharge and recover the refrigerant. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.
   - Repair the system.
   - Test the system for normal operation.



Fluorescent Dye Leak Detection

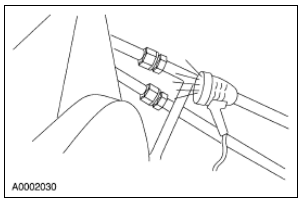
Special Tool(s)

 ST1834-A	R-134a Refrigerant Service Center 023-00153 or equivalent
 ST1261-A	120 Watt UV Spot Lamp 164-R0721 or equivalent
 ST1705-B	R-134a Fluorescent Dye Injector 164-R0775 or equivalent
 ST2651-A	High Intensity UV Lamp 12 Volt 164-R6000
 ST2650-A	R-134a Leak Detection Dye 164-R6060
 ST1928-A	R-134a Manifold Gauge Set 176-R032A
 ST2649-A	Deluxe Injector Loop Kit 219-00069

Fluorescent Dye Detection

NOTE: Ford Motor Company vehicles are produced with R-134a fluorescent dye installed in the refrigerant system from the factory. The location of leaks can be pinpointed by the bright yellow-green glow of the fluorescent dye under a UV lamp. Since more than one leak can exist, make sure to inspect each component, line, and fitting in the refrigerant system for a leak.

1. Check for leaks using the special tool.
   - Inspect all components, lines, and fittings of the refrigerant system.


A0002030

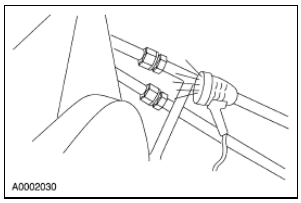
2. If a leak is found, recover the refrigerant. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

3. Repair the refrigerant system leak(s).

4. Evacuate and charge the refrigerant system. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

5. After the leak(s) is/are repaired, remove any traces of fluorescent dye with a general purpose oil solvent.

6. Verify the repair by running the vehicle for a short period of time and rechecking the area of the leak with the special tool.



Fluorescent Dye Injection Using an A/C Refrigerant Center and Dye Injector

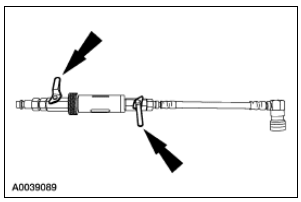
NOTE: Before using the R-134a fluorescent dye injector for the first time, refer to the manufacturers instructions on evacuation of any non-condensable gasses from the hoses.

NOTE: Only connect the R-134a fluorescent dye injector to a manifold and gauge set or R-134a service center when fluorescent dye is to be injected. The R-134a fluorescent dye injector has a one way check valve that will prevent refrigerant system recovery and evacuation.

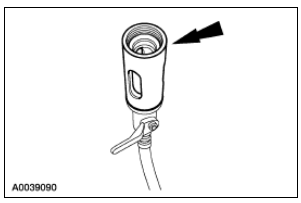
NOTE: Refrigerant system pressure should be between 413-551 kPa (60-80 psi) at 24°C (75°F) with the engine off.

1. Install an R-134a A/C refrigerant service center or a manifold and gauge set. For additional information, refer to Manifold and Gauge Set Connection in this section.

2. Verify that the valves on the special tool are closed.



3. Fill the special tool reservoir with 7 ml (0.25 oz) of fluorescent dye.



4. Install the special tool between the low-pressure service gauge port valve and the R-134a refrigerant service center or manifold gauge set.

5. Open all valves and inject the fluorescent dye into the refrigerant system.

6. When fluorescent dye injection is complete, close all valves.

7. Recover the refrigerant from the R-134a fluorescent dye injector.

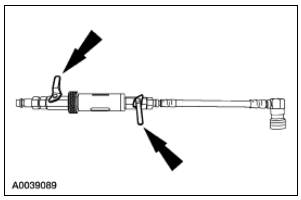
8. Remove the fluorescent dye injector from the low-pressure service gauge port valve and the R-134a A/C refrigerant service center or manifold gauge set.

Fluorescent Dye Injection Using a Dye Injector Loop Kit

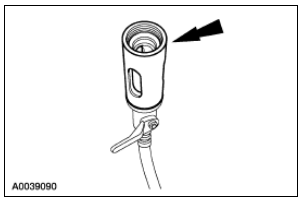
NOTE: Before using the R-134a fluorescent dye injector for the first time, refer to the equipment manufacturers instructions on evacuation of non-condensable gasses from the hoses.

NOTE: Refrigerant system pressure should be between 413-551 kPa (60-80 psi) at 24°C.

1. Verify that the valves on the special tool are closed.



2. Fill the special tool reservoir with 7 ml (0.25 oz) of fluorescent dye.

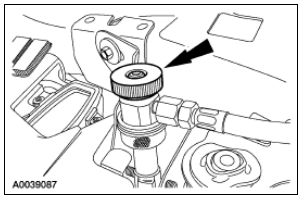


3. Install the special tool between the high-pressure and low-pressure service gauge port valves.

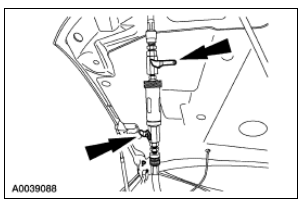
4. ⚠ **CAUTION: Make sure all tools and hoses are clear of the engine cooling fan and drive belt before starting the engine.**

   Start the engine.

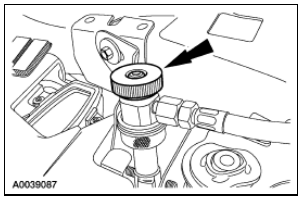
5. Open the high-pressure service valve.



6. Open the special tool valves and inject the fluorescent dye into the refrigerant system.

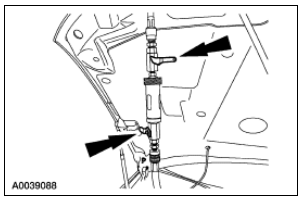


7. Close the high-pressure service valve to allow the pressure inside the special tool to equalize with the suction side of the refrigerant system.



8. **NOTE:** Close the valves on the special tool while the A/C compressor is operating.

   Close the valves on the special tool.

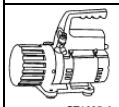
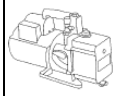


9. **NOTE:** Leave all valves on the special tool closed when not in use.

   Disconnect the high-pressure and low-pressure service valves and remove the special tool from the vehicle.

Air Conditioning (A/C) System Recovery, Evacuation and Charging

Special Tool(s)

 ST1226-A	R-134a A/C Refrigerant Center 176-00002 or equivalent
 ST1834-A	R-134a A/C Refrigerant Center 023-00153 or equivalent
 ST1928-A	R-134a Manifold Gauge Set 176-R032A or equivalent
 ST1685-A	1.2 CFM Vacuum Pump 023-00162 or equivalent
 ST1686-A	4.0 CFM Vacuum Pump 023-00163 or equivalent

Refrigerant System Recovery

NOTE: Ford Motor Company recommends use of an A/C service center to carry out recovery, evacuation, and charging of the refrigerant system. If an A/C service center is not available, refrigerant system recovery, evacuation, and charging may be accomplished using a separate recovery station, vacuum pump, charging cylinder, and manifold gauge set.

1. Prior to recovering the refrigerant system, you must verify the purity of the refrigerant. For additional information, refer to Refrigerant Identification Testing in this section.

2. **NOTE:** Some R-134a service centers require the use of an A/C manifold gauge set. For additional information, refer to Manifold Gauge Set Connection in this section.

   Connect an R-134a A/C service center to the low- and high-pressure service gauge port valves.

3. Recover the refrigerant from the system following the operating instructions provided by the equipment manufacturer.

4. Once the service center has recovered the vehicle A/C system refrigerant, close the service center inlet valve (if equipped). Then switch off the power supply.

5. Allow the vehicle A/C system to remain closed for about two minutes. Observe the system vacuum level as shown on the gauge. If the vacuum does not decrease, disconnect the refrigerant center hose(s).

6. If the system vacuum does decrease, repeat Steps 2 through 5 until the vacuum level remains stable for two minutes.

7. Carry out the required repairs.

Refrigerant System Evacuation

NOTE: Ford Motor Company recommends use of an A/C service center to carry out recovery, evacuation, and charging of the refrigerant system. If an A/C service center is not available, refrigerant system recovery, evacuation, and charging may be accomplished using a separate recovery station, vacuum pump, charging cylinder, and manifold gauge set.

1. Connect an R-134a service center to the low- and high-pressure service gauge port valves.

2. Evacuate the system until the low-pressure gauge reads at least 99.4 kPa (29.5 in-Hg) of vacuum and as close to 101.1 kPa (30 in-Hg) as possible. Continue to operate the vacuum pump for a minimum of 45 minutes.

3. Turn off the vacuum pump. Observe the low-pressure gauge for five minutes to make sure that the system vacuum is held. If vacuum is not held for five minutes, leak test the system, service the leak, and evacuate the system again.

Refrigerant System Charging

NOTE: Ford Motor Company recommends use of an A/C service center to carry out recovery, evacuation, and charging of the refrigerant system. If an A/C service center is not available, refrigerant system recovery, evacuation, and charging may be accomplished using a separate recovery station, vacuum pump, charging cylinder, and manifold gauge set.

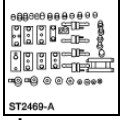
1. Correctly oil match the system to verify that the correct amount of refrigerant oil is present in the system. For additional information, refer to Refrigerant Oil Adding in this section.

2. Charge the system with the specified amounts of refrigerant oil and refrigerant.

3. When no more refrigerant is being drawn into the system, start the engine and select MAX A/C operation. Adjust the blower motor speed to the maximum and allow the remaining refrigerant to be drawn into the system. Continue to add refrigerant into the system until the specified weight of R-134a has been added. Close the charging cylinder valve and allow the system to pull any remaining refrigerant from the hose. When the low-pressure drops to approximately 207 kPa (30 psi), close the charging hose valve.

Air Conditioning (A/C) System Flushing

Special Tool(s)

 ST2466-A	A/C Flush and Purge Machine 219-00022 (part of 219-00023) or equivalent
 ST2469-A	A/C Flush and Purge Fitting Kit 219-00024 (part of 219-00023) or equivalent

⚠ WARNING: Use extreme care and observe all safety and service precautions related to the use of refrigerants.

⚠ WARNING: Due to refrigerant hazards, always wear safety goggles and non-penetrable gloves when working on or flushing A/C systems.

⚠ CAUTION: An A/C refrigerant analyzer must be used before the recovery of any vehicle's A/C refrigerant. Failure to do so puts the shop's bulk refrigerant at risk of contamination. If the vehicle's A/C refrigerant is contaminated, refer the customer to the service facility that carried out the last A/C service. If the customer wishes to pay the additional cost, use the A/C recovery equipment that is designated for recovering contaminated A/C refrigerant. All contaminated A/C refrigerant must be disposed of as hazardous waste. For all equipment, follow the equipment manufacturer's procedures and instructions.

⚠ CAUTION: Suction accumulator, muffler, hoses, and fixed orifice tube should be removed when flushing the A/C system. Internal plumbing of these devices makes it impossible to correctly remove any residual-flushing agent. Except for the hoses, these components are typically discarded after A/C system contamination. Hoses without mufflers can normally be reused unless they are clogged with foreign material. The 3.785 liters (1 gallon) of A/C Systems Flushing Solvent F4AZ-19579-A and FL1-A filter used in A/C Flush and Purge Machine 219-00022 are intended for use on one vehicle only. They may be used to flush both the A/C condenser core and the A/C evaporator core on an individual vehicle, but under no circumstances should they be used on more than one vehicle.

1. **NOTE:** Prior to using the A/C Flush and Purge Machine 219-00022 for the first time, review the operating instructions.

   NOTE: Only the A/C Flush and Purge Machine kit 219-00023, which includes A/C Flush and Purge Machine 219-00022, A/C Flush and Purge Fitting Kit 219-00024, and the Ford Part number F4AZ-19579-A A/C Systems Flushing Solvent, is approved for use on Ford vehicles. No other flushing device or solvent is approved for flushing heat exchangers. Use of any other flusher or solvent may cause damage to the A/C system and the flushing unit.

   Ford Motor Company has approved a procedure to provide technicians with a non-CFC method of flushing contaminated A/C system heat exchangers, A/C evaporator core, and A/C condenser core. The procedure allows the specific components to be cleaned and flushed while installed in their normal in-vehicle location. The types of contamination flushed include particle matter that results from A/C compressor or desiccant failure within the suction accumulator and gummy residue that can form when refrigerant oil is overheated during A/C compressor seizure. The flushing process is a two-step procedure that involves the use of an A/C Flush and Purge Machine 219-00022 to:

- Circulate the flushing solvent through the heat exchanger in the reverse direction of normal refrigerant flow (back-flushing). Particulate matter picked up during flushing is filtered from the returning solvent before the solvent is returned to the reservoir for continued circulation.
- Remove the flushing solvent from the heat exchanger. In this step of the procedure, pressurized air 621-862 kPa (90-125 psi) is used to push and evaporate any remaining flush solvent from the heat exchanger.

2. Discharge the A/C system. Observe all safety precautions. For additional information, refer to the procedure in this section.

3. Disconnect the refrigerant lines from the heat exchanger(s) to be flushed.

4. Connect the A/C Flush and Purge Machine 219-00022 and A/C Flush and Purge Fitting Kit 219-00024 to the heat exchanger to be flushed. Do not flush through the evaporator core orifice, mufflers or hoses. Internal plumbing and material make-up of these components make it impossible to correctly remove foreign material or residual flushing solvent.

5. Use 3.785 liters (one gallon) of A/C Systems Flushing Solvent part number F4AZ-19579-A to flush the heat exchanger for a minimum of 15 minutes. The flush solvent may be used for one or both heat exchangers in the A/C system. However, the flush solvent is intended for one vehicle only. The filter used on the flushing unit is also intended for use on one vehicle only.

6. Flush the component for a minimum of 15 minutes.

7. Apply 621-862 kPa (90-125 psi) pressurized air to the component for a minimum of 30 minutes. The 30-minute purge time is required to force and evaporate all residual solvent from the A/C system component. Failure to successfully remove all residual solvent within the component can result in system damage when reconnected and operated. Dispose of the used flush solvent and filter in accordance with local, state and federal emissions.

8. **NOTE:** A/C system filtering as described in this section is optional if system flushing is carried out. However, the filter kit use is recommended after flushing if the A/C system contamination is extensive.

   Install a new evaporator core orifice in any vehicle being serviced for A/C compressor or desiccant failure.

9. Install new refrigerant hoses if clogged with foreign material.

10. Reconnect the heat exchanger being serviced.

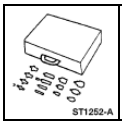
11. Add additional refrigerant oil as required. For additional information, refer to the procedure in this section.

12. Evacuate, leak test and charge the A/C system. For additional information, refer to the procedure in this section.

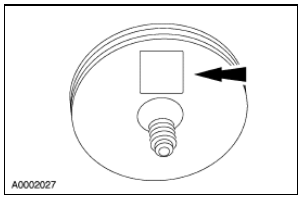
13. Check the system for normal operation.

Refrigerant System Filtering After A/C Component Replacement

Special Tool(s)

 ST1252-A	Set, A/C Fittings 412-DS028 (014-00333, D93L-19703-B) or equivalent

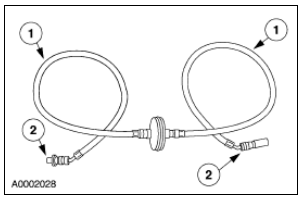
1. Install the new A/C compressor. For additional information, refer to Section 412-03 .
2. Install the new receiver drier. For additional information, refer to Section 412-03 .
3. Install the new thermostatic expansion valve. For additional information, refer to Section 412-03 .
4. Orient the filter inlet toward the A/C condenser core.



5. **NOTE:** The pancake filter is not permanently installed and will be removed at the end of this procedure.

   Temporarily install the pancake filter between the A/C condenser core and the condenser to evaporator tube (19835).

   1. Use flexible refrigerant hose of 17,238 kPa (2,500 psi) burst rating.
   2. Make the connections using the R-12/R-134a Air Conditioning Test Fitting Set.



6. Correctly oil match the system. For additional information, refer to Refrigerant Oil Adding in this section.
7. Evacuate and charge the system. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.
8. Check all refrigerant system hoses, lines and the position of the newly installed filters to be sure they do not interfere with other engine compartment components. If necessary, use tie straps to make adjustments.

9. Provide adequate airflow to the front of the vehicle (with a fan, if necessary). Select A/C operation and set the blower motor speed to maximum. Start the engine and let it idle briefly. Make sure the A/C system is operating correctly.

10. Gradually bring the engine up to 1,200 rpm by running it at lower rpms for short periods (first at 800 rpm, then at 1,000 rpm). Set the engine at 1,200 rpm and run it for one hour with the A/C system operating.

11. Stop the engine.

12. Recover the refrigerant from the system. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

13. Remove the fittings, flexible hoses and pancake filter from between the A/C condenser core and the condenser to evaporator tube.

14. Discard the pancake filter. It can be used one time only.

15. Reconnect the condenser to evaporator tube to the A/C condenser core.

16. Evacuate and charge the system. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

Refrigerant Oil Adding

⚠ CAUTION: During normal A/C operation, oil is circulated through the system with the refrigerant, and a small amount is retained in each component. If certain components of the system are removed, some of the refrigerant oil will go with the component. To maintain the original total oil charge, it is necessary to compensate for the oil lost by adding oil to the system with the new part.

NOTE: Installation of new components such as the A/C pressure transducer do not require additional oil.

1. **NOTE:** New A/C compressors are shipped without compressor oil.

   Rotate the A/C compressor shaft six to eight revolutions while collecting the oil in a clean measuring device.

   - If the amount of oil drained from the old A/C compressor is between 90-150 ml (3-5 ounces), pour the same amount plus 30 ml (1 ounce) of clean PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B into the new A/C compressor.
   - If the amount of oil that was removed from the old A/C compressor is greater than 150 ml (5 ounces), pour the same amount drained of clean PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B into the new A/C compressor.
   - If the amount of oil that was removed from the old A/C compressor is less than 90 ml (3 ounces), pour 90 ml (3 ounces) of clean PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B into the new A/C compressor.

2. For the receiver drier, drill one 12.7 mm (0.5 in) hole in the receiver drier cylinder and drain the oil into a calibrated container.
   - Add a quantity of new oil to match that drained from the old receiver drier plus 59 ml (2 ounces) of clean PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.

3. For the A/C evaporator core add 30 ml (1 ounce) of clean PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B to the receiver drier inlet tube.

4. For the A/C condenser core, add 30 ml (1 ounce) of clean PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B to the A/C condenser core or the receiver drier inlet tube.

5. Add 20 ml (.75 ounces) of clean PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B to the receiver drier inlet tube when carrying out each of the following repairs:
   - installation of a new TXV
   - installation of a new A/C compressor pressure relief valve (19D644)
   - installation of a new refrigerant line
   - repair of an O-ring seal leak
   - repair of a charge port leak

Inspection and Assembly Requirements Following An A/C Compressor Failure

⚠ CAUTION: To prevent refrigerant system contamination and possible failure of the new A/C compressor, carry out the following procedures:

1. Install a new thermostatic expansion valve (TXV). For additional information, refer to Section 412-03 .

2. Remove the A/C compressor. For additional information, refer to Section 412-03 .
   - Drain the residual refrigerant oil from the A/C compressor and measure the volume for correct system oil matching. For additional information, refer to Refrigerant Oil Adding in this section.

3. **NOTE:** The thermostatic expansion valve cannot be cleaned and a new thermostatic expansion valve must be installed.

   Remove the receiver/drier. For additional information, refer to Section 412-03 .

   - Drain the residual refrigerant oil from the receiver/drier and measure the volume for correct oil system matching. For additional information, refer to Refrigerant Oil Adding in this section.

4. **NOTE:** System flushing is the preferred method of cleaning. However, if flushing equipment is not available, carry out system filtering.

   Carry out an A/C system flushing or filtering procedure:

   - If A/C system flushing equipment is available, clean the A/C condenser core by flushing. For additional information, refer to Air Conditioning (A/C) System Flushing in this section.
   - If A/C system flushing equipment is not available, carry out a system filtering procedure. For additional information, refer to Refrigerant System Filtering After A/C Component Replacement in this section.

5. Install the new A/C compressor. For additional information, refer to Section 412-03 .

6. Install the new receiver/drier, if necessary. For additional information, refer to Section 412-03 .

7. Install the new TXV. For additional information, refer to Section 412-03 .

8. Correctly oil match the system. For additional information, refer to Refrigerant Oil Adding in this section.

9. Evacuate and charge the system. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

Refrigerant Identification Testing

Special Tool(s)

 ST1457-A	Refrigerant Identifier with Air-Radicator 198-00003 or equivalent

1. **NOTE:** An A/C refrigerant analyzer must be used to identify gas samples taken directly from the refrigeration system or storage containers prior to recovering or charging the refrigerant system.

   Follow the instructions included with the Deluxe Refrigerant Diagnostic Tool to obtain the sample for testing.

2. The diagnostic tool will display one of the following:
   - If the purity level of R-134a or R-12 is 98% or greater by weight, the green "PASS" light emitting diode (LED) will light. The weight concentrations of R-134a, R-12, R-22, hydrocarbons, and air will be displayed on the digital display.
   - If refrigerants R-134a or R-12 do not meet the 98% purity levels, the red "FAIL" LED will light and a horn will sound alerting the user of potential hazards. The weight concentrations of R-134a, R-12, R-22, and hydrocarbons will be displayed on the digital display.
   - If hydrocarbon concentrations are 2% or greater by weight, the red "FAIL" LED will light, "Hydrocarbon High" will be displayed on the digital display, and a horn will sound alerting the user of potential hazards. The weight concentrations of R-134a, R-12, R-22, and hydrocarbons will also be displayed on the digital display.

3. The percentage of air contained in the sample will be displayed if the R-134a or R-12 content is 98% or greater. The diagnostic tool eliminates the effect of air when determining the refrigerant sample content because air is not considered a contaminant, although air can affect A/C system performance. When the diagnostic tool has determined that a refrigerant source is pure (R-134a or R-12 is 98% or greater by weight) and air concentration levels are 2% or greater by weight, the diagnostic tool will prompt the user if an air purge is desired.

4. If contaminated refrigerant is detected, repeat the refrigerant identification test to verify that the refrigerant is indeed contaminated.

5. ⚠ **CAUTION: If contaminated refrigerant is detected, DO NOT recover the refrigerant into R-134a or R-12 recovery/recycling equipment.**

   Recover any contaminated refrigerant using suitable recovery-only equipment designed for capturing and storing contaminated refrigerant. For additional information, refer to Contaminated Refrigerant Handling in this section.

Contaminated Refrigerant Handling

1. ⚠ **CAUTION: If contaminated refrigerant is detected, DO NOT recover the refrigerant into your recovery/recycling equipment.**

   Recover the contaminated refrigerant using suitable recovery-only equipment designed for capturing and storing contaminated refrigerant.

   - This equipment must only be used to recover contaminated refrigerant to prevent the spread to other vehicles.
   - If this equipment is not available, contact an A/C repair facility in your area with the correct equipment to carry out this repair.

2. Determine and correct the cause of the customer's initial concern.

3. **NOTE:** Residual refrigerant oil in the receiver drier must be drained and measured for correct oil system matching. For additional information, refer to Refrigerant Oil Adding in this section.

   NOTE: The receiver drier cannot be cleaned and a new receiver drier must be installed.

   Remove the receiver drier. For additional information, refer to Section 412-03 .

4. Clean the A/C evaporator core and the A/C condenser core by flushing. For additional information, refer to Air Conditioning (A/C) System Flushing in this section.

5. Install the new receiver drier. For additional information, refer to Section 412-03 .

6. Correctly oil match the system. For additional information, refer to Refrigerant Oil Adding in this section.

7. Evacuate and charge the system. For additional information, refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging in this section.

8. Dispose of contaminated refrigerant according to all federal, state and local regulations.

Torque Specifications

Description	Nm	lb-ft	lb-in
Cross-vehicle support bolts	25	18	
Cabin air filter plenum bolts	6		53
Plenum chamber center screws to cross-vehicle beam	6		53
Plenum chamber lower screw to cross-vehicle beam	6		53

Air Distribution And Filtering

NOTE: The air distribution system of this vehicle is factory equipped with a cabin air filter.

There are two sources of air available to the air distribution system:

- outside air
- recirculated air

Air distribution within the vehicle is controlled by the dual electronic automatic temperature control (DATC) system in the AUTOMATIC mode, but it can be overridden by the driver if desired. Airflow control doors are used to direct airflow within the evaporator and blower assembly (19B555) and within the plenum chamber (19740). Electrically powered actuators (19E616) are used to position the airflow control doors. For additional information, refer to Section 412-00 for description and operation of each of the system functions.

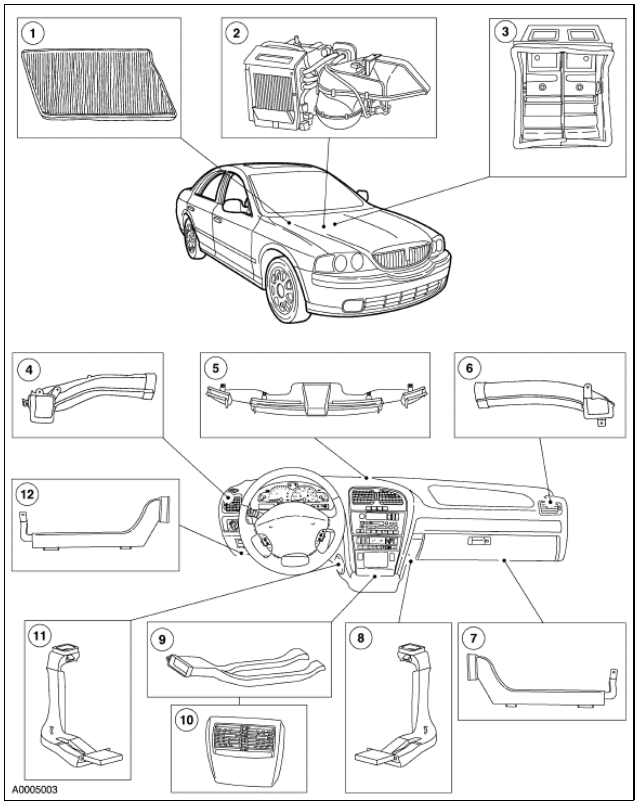
Recirculated air can be selected by pushing the recirculating air button on the dual automatic temperature control panel. It may also be commanded by the DATC during AUTOMATIC and OFF modes. If the recirculating mode is selected in floor mode, the DATC module will automatically discontinue the recirculating air mode in floor mode, to reduce fogging of the windows.

Air enters the passenger compartment from the:

- instrument panel A/C registers (19893).
- heater outlet floor duct.
- windshield defroster hose nozzle (18490).
- side window demisters.
- center console rear A/C registers.
- rear seat floor ducts (18C464).

Passenger compartment air is exhausted from the vehicle through open windows or luggage compartment air vents.

Component Locations



Item	Part Number	Description
1	19N619	Cabin air filter
2	19850	A/C evaporator housing
3	19740	Plenum chamber
4	19B680	LH register duct
5	18C433	Defroster duct
6	19A843	RH register duct
7		RH floor duct
8	18C464	RH rear seat duct
9	19E766	Center console duct
10		Center console register
11	18C464	LH rear seat duct
12		LH floor duct

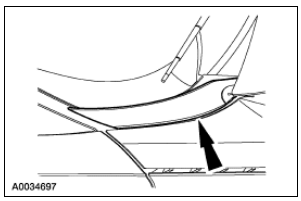
Air Distribution And Filtering

Refer to Section 412-00 .

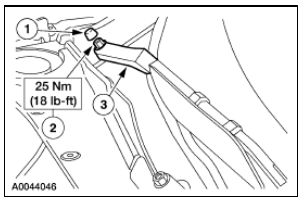
Cabin Air Filter

Removal and Installation

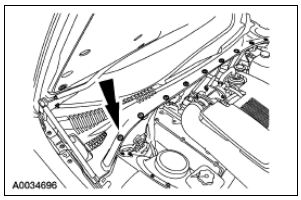
1. Remove the LH and RH cowl side trim pieces.



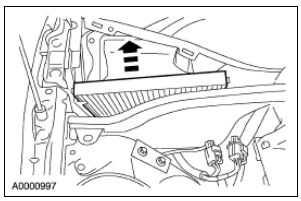
2. Remove the windshield wiper pivot arms.
    1. Remove the nut cover.
    2. Remove the nut.
    3. Remove the pivot arm.



3. Position the cowl vent screen aside.
    - Remove the pin-type retainers.
    - Disengage the retaining clips.



4. Push on the RH corner of the filter to release the clip. Release the LH clip and remove the cabin air filter.



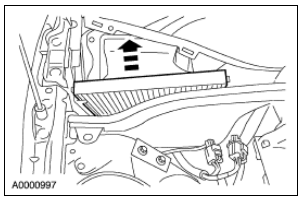
5. To install, reverse the removal procedure.
    - When installing, align the windshield wiper pivot arms with the orange alignment marks on the windshield.

Fresh Air Inlet Duct

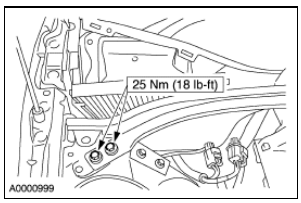
Removal and Installation

1. Remove the cowl vent screen. For additional information, refer to Section 501-02 .

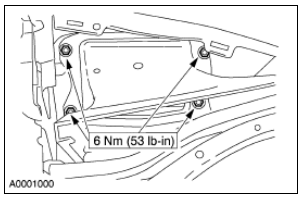
2. Push on the RH corner of the filter to release the clip. Release the LH clip and remove the cabin air filter.



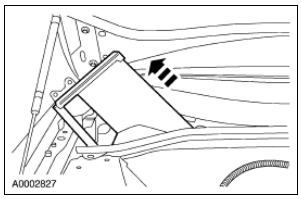
3. Remove the seven bolts and remove the cross-vehicle support.



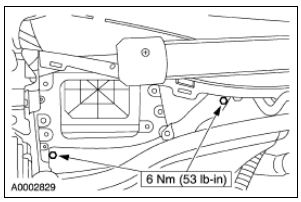
4. Remove the bolts.



5. Remove the cabin air filter housing by lifting the outboard side then removing the housing.



6. Remove the three bolts and remove the plenum panel.



7. To install, reverse the removal procedure.

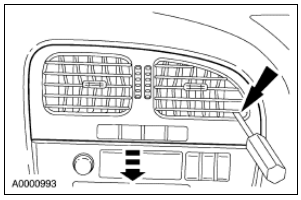
Center Registers

Removal

1. **NOTE:** The center register has pockets in the lower RH and LH corners to assist in removal.

   Insert a mini-pick in the pocket and pull the register from the instrument panel.

   - Disconnect the message center connector, if equipped.



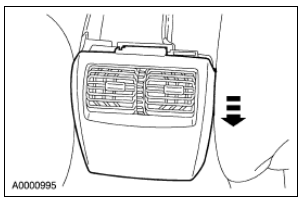
Installation

1. To install, connect the message center connector, if equipped, position the register and press into place.

Floor Console Register

Removal and Installation

1. Lift the center console cover and pull the register from the center console.



2. To install, reverse the removal procedure.

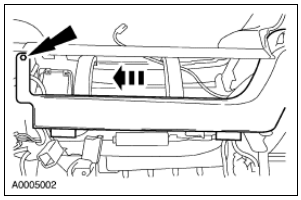
Footwell Duct

Removal and Installation

1. Remove the lower instrument panel insulator.
   - Disconnect the electrical connector.

2. **NOTE:** RH shown, LH similar.

   Remove the screw and remove the duct.



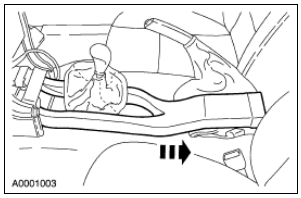
3. To install, reverse the removal procedure.

Footwell Duct Floor Console

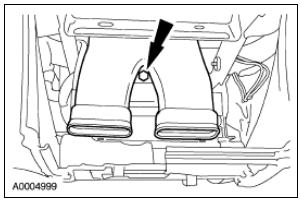
Removal and Installation

1. Remove the floor console. For additional information, refer to Section 501-12 .

2. Remove the duct.



3. Remove the screw and remove the front portion of the duct.



4. To install, reverse the removal procedure.

Rear Footwell Duct

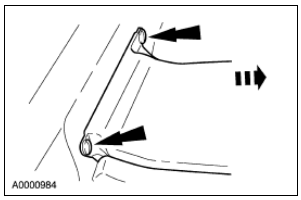
Removal and Installation

1. **NOTE:** RH shown, LH similar.

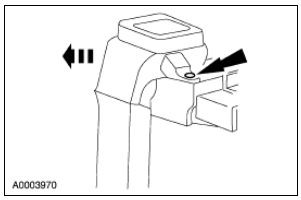
   Remove the front seat. For additional information, refer to Section 501-10 .

2. Remove the carpet.

3. Remove the pin-type retainers.



4. Remove the pin-type retainer. Move the duct outboard and remove the duct.



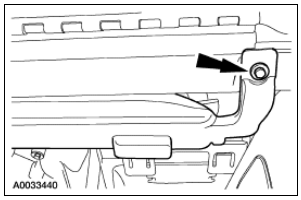
5. To install, reverse the removal procedure.

Plenum Chamber

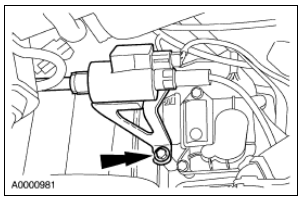
Removal and Installation

1. Remove the instrument panel. For additional information, refer to Section 501-12 .
2. **NOTE:** Passenger side duct shown, driver side similar.

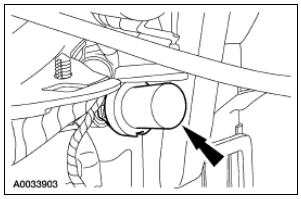
   Remove the screws and remove the floor ducts.



3. Remove the screws and detach the transmission shift lockout bracket from the plenum chamber.

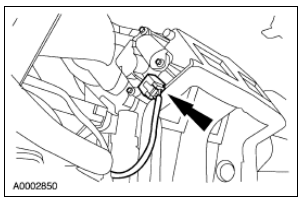


4. Detach the venturi assembly from the plenum chamber.

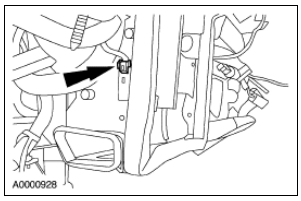


5. **NOTE:** Panel door actuator shown, defrost door and floor door actuators similar.

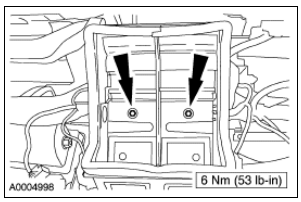
   Disconnect the electrical connectors from the panel door, defrost door and floor door actuators.



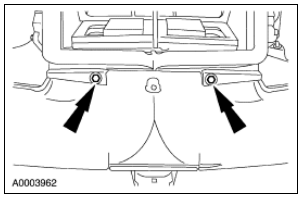
6. Disconnect the two air discharge temperature sensors from the plenum chamber.



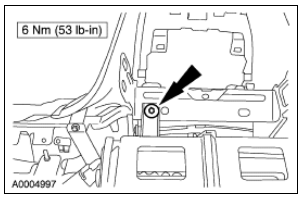
7. Remove the screws.



8. Remove the screws.



9. Remove the screw.



10. Remove the plenum chamber.

11. If a new plenum chamber is to be installed, transfer the mode door actuators from the old unit to the new unit. For additional information, refer to Section 412-04 .

12. If a new plenum chamber is to be installed, transfer the venturi cap from the old unit to the new unit.

13. To install, reverse the removal procedure.

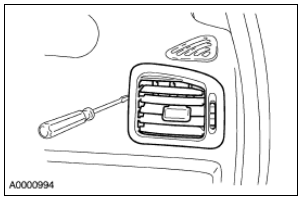
Instrument Panel Air Distribution Ducts

Disassembly and Assembly

1. **NOTE:** RH register shown LH similar.

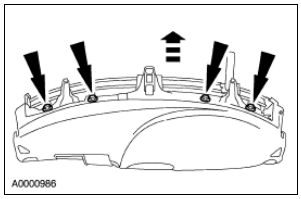
   Remove the LH and RH panel registers.

   - Depress the inboard side tab with a flat blade tool. Pull the register rearward, depress the outboard tab and remove the register.

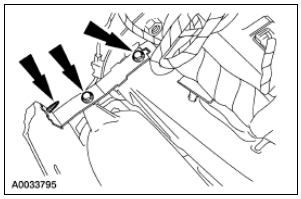


2. Remove the plenum chamber. For additional information, refer to Plenum Chamber in this section.

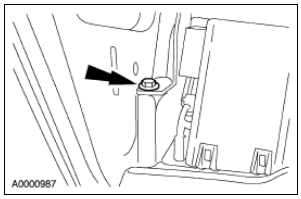
3. Remove the screws and remove the defroster duct.



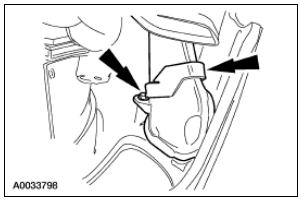
4. Remove the screws and remove the driver side support brace.



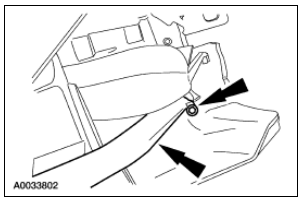
5. Remove the screw and position the driver side panel duct away from the driver side demister duct screw.



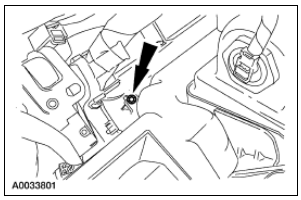
6. Remove the driver side demister duct screw and remove the driver side demister duct.



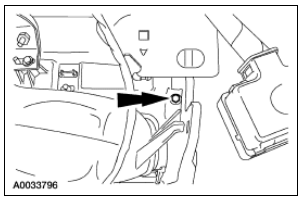
7. Remove the passenger side demister duct screw and remove the passenger side demister duct.



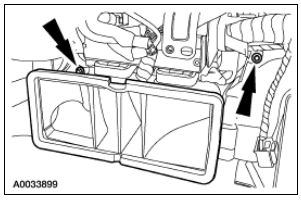
8. Remove the passenger side panel duct inner screw.



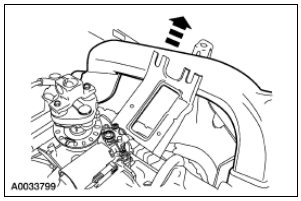
9. Remove the passenger side panel duct outer screw.



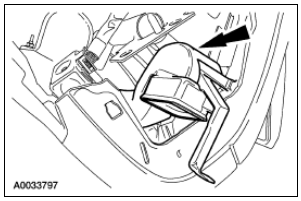
10. Remove the screws and remove the center panel duct.



11. Remove the driver side panel duct.



12. Rotate and pull the panel duct through the opening in the side of the instrument panel.



13. To assemble, reverse the disassembly procedure.

General Specifications

Item	Specification
Lubricants	
MERPOL®	ESE-M99B144-B
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B
Refrigerant	
R-134a Refrigerant YN-19	WSH-M17B19 A
Capacity kg (oz)	0.79 (28)

Torque Specifications

Description	Nm	lb-in
Evaporator housing mounting nuts	7	62
Cowl top attachment bolt	7	62
Coolant valve mounting bracket bolts	9	80
Coolant valve assembly mounting bolts	9	80
Auxiliary coolant pump mounting bolts	6	53
Rear hose assembly mounting bolt	9	80
Forward heater hose mounting bolt	9	80
Evaporator housing attachment bolt	5	44

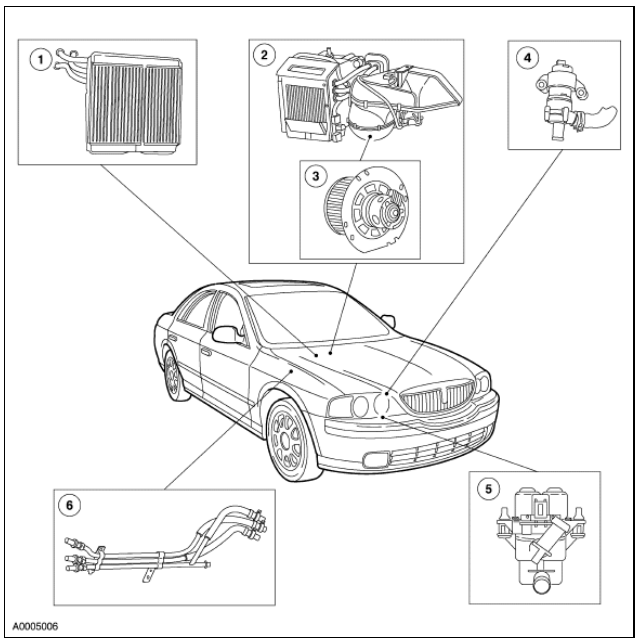
Heating and Defrosting

The heating and defrosting system:

- controls the vehicle air temperature and, during A/C operation, reduces the relative humidity of the air inside the vehicle.
- delivers heated or cooled air to maintain the vehicle interior temperature and comfort level.
- controls the A/C blower motor speed.
- allows temperature to be adjusted individually by the driver and the passenger to maintain comfort.
- uses a reheat method to provide conditioned air to the passenger compartment. All airflow from the blower motor passes through the A/C evaporator core (19860) and the heater core (18476). Temperature is regulated by reheating the air out of the evaporator core to achieve the desired temperature.
- controls the air temperature by regulating the flow of engine coolant to separate halves of the heater core. A dual solenoid actuated valve is used to control the flow of coolant.

The blower motor (19805) draws outside air through the air inlet filter and duct or draws recirculated air through the recirculated air duct.

Component Locations



Item	Part Number	Description
1	18476	Heater core
2	19850	A/C evaporator housing
3	19805	Blower motor
4	18D473	Auxiliary coolant flow pump 3.9L only
5	18495	Dual coolant flow valve
6	18C553	Heater water hose assembly (consists of 18663 and two 18696 hose assemblies)

Heater Core

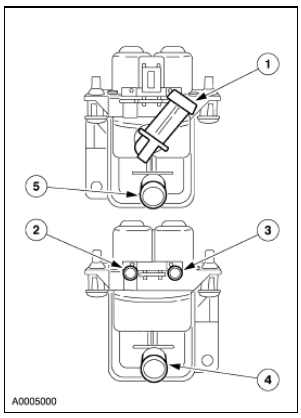
The heater core consists of fins and tubes arranged to extract heat from the engine coolant and transfer it to air passing through the heater core. The heater core is separated into two sections. Air passing through one section is directed to the driver side of the vehicle, while air passing through the other section is directed to the passenger side of the vehicle. The heater core has separate inlet ports with a common outlet port.

Blower Motor

The A/C blower motor (19805) pulls air from the air inlet and forces it into the evaporator housing and plenum assembly (which is attached to the instrument panel) where it is distributed.

Dual Coolant Control Valve

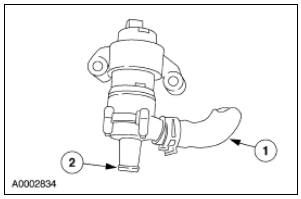
The dual coolant valves regulates the flow of engine coolant to each half of the heater core. Two electric solenoids, which are individually actuated by the DATC module, are the control elements. The valve contains five ports:



Port	Function	Location
1	Inlet coolant from engine	front face
2	Outlet to heater core, driver side	rear face
3	Outlet to heater core, passenger side	rear face
4	Return coolant from heater core	rear face
5	Outlet return to engine	front face

Auxiliary Water Pump 3.9L Engine

The auxiliary water pump is electrically driven and provides increased coolant flow during low engine speed operation. The pump is also used to circulate coolant after the engine is turned off under certain conditions.



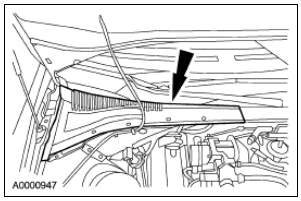
Port	Description
1	Inlet from engine

2	Outlet to coolant valve

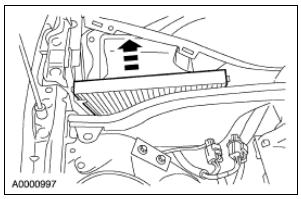
Heater Hose Assembly

Removal

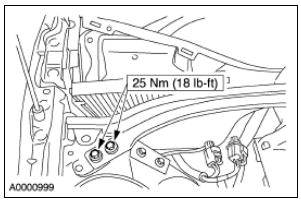
1. Drain the radiator. For additional information, refer to Section 303-03 .
2. Remove the throttle body air intake tube. For additional information, refer to Section 303-12 .
3. Remove the RH cowl cover.



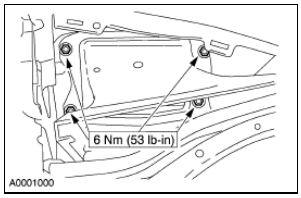
4. Push on the RH corner of the filter to release the clip. Release the LH clip and remove the cabin air filter.



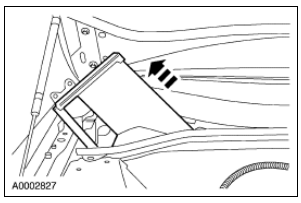
5. Remove the seven bolts and remove the cross-vehicle support.



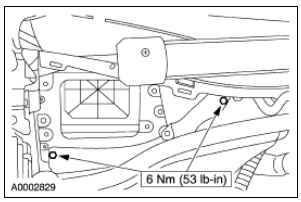
6. Remove the bolts.



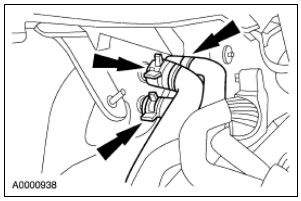
7. Remove the cabin air filter housing by lifting the outboard side then removing the housing.



8. Remove the three bolts and remove the plenum panel.



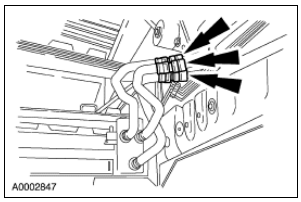
9. Disconnect the heater hoses from the heater core.



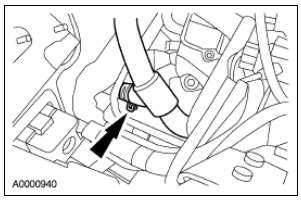
10. **NOTE:** The top heater hose has a green identifying mark to match the hose on the dual coolant flow valve. If the marking is not visible, make sure to mark the hoses for location prior to disconnecting the couplings. This will aid in the correct installation of the hose assemblies.

    NOTE: Hose connections shown with components removed for clarity.

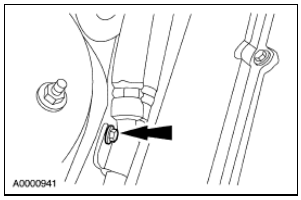
    Disconnect the three quick-disconnect couplings from the coolant control valve hoses. For additional information, refer to Section 412-00 .



11. Disconnect the coolant recovery line.



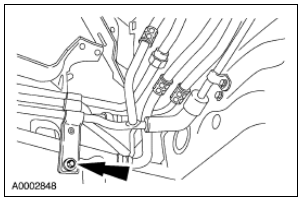
12. Remove the forward heater hose mounting bolt at the RH shock tower.



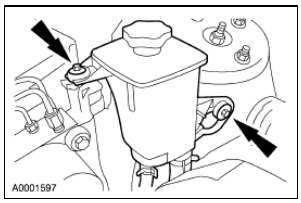
13. Raise the vehicle. For additional information, refer to Section 100-02 .

14. **NOTE:** View shown with components removed for clarity.

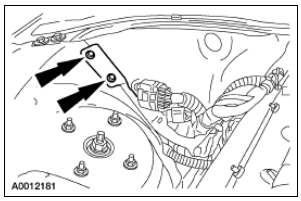
    Remove the rear heater hose mounting bolt from the body side.



15. Position the hydraulic cooling fan reservoir aside.

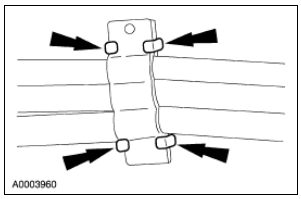


16. Position the PCM wiring harness bracket aside.

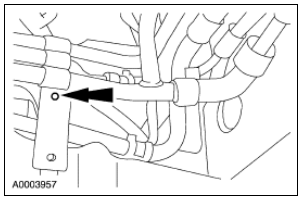


17. Lower the vehicle and remove the heater hose assembly.
18. **NOTE:** Steps 18 and 19 are required only if the heater hose assembly is being separated.

    If necessary, remove the crimps and remove the bracket.

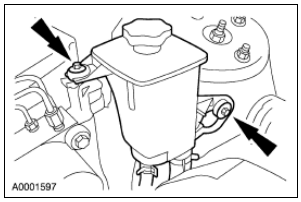


19. If necessary, remove the rivet and remove the bracket.

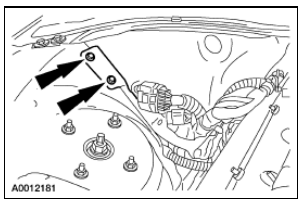


Installation

1. Install heater hose assembly.
2. Install the hydraulic cooling fan reservoir.

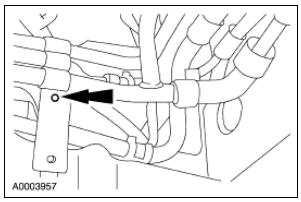


3. Install the PCM wiring harness bracket.

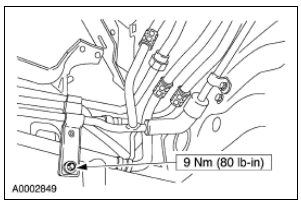


4. **NOTE:** If the hose assembly has been separated, install the bracket removed using a new rivet.

   Install the bracket using a new rivet.

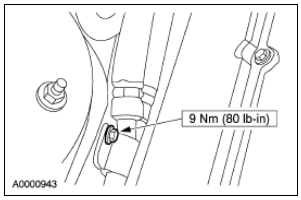


5. Install the rear heater hose mounting bolt.

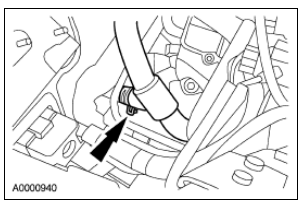


6. **NOTE:** If the hose assembly has been separated, a new bracket must be installed.

   Install the forward heater hose mounting bolt.

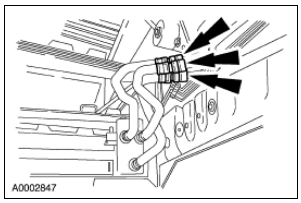


7. Connect the coolant recovery line.

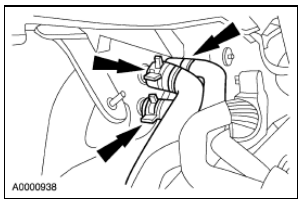


8. Install the couplings.

- Make sure that the heater hoses are installed in the correct position. For additional information, refer to Heating and Defrosting in this section.
- Lubricate the coolant hoses with MERPOL® meeting Ford specification ESE-M99B144-B or plain water only, if needed.



9. Install the heater hoses at the heater core.
   - Make sure that the heater hoses are installed in the correct position. For additional information, refer to Heating and Defrosting in this section.
   - Lubricate the coolant hoses with MERPOL® meeting Ford specification ESE-M99B144-B or plain water only, if needed.
   - Check for correct hose installation by verifying DATC system operation.

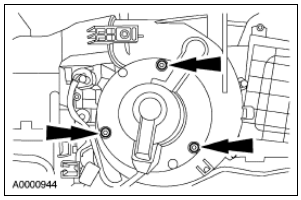


10. Install the cabin air intake plenum.
11. Install the cabin air filter.
12. Install the RH cowl cover.
13. Install the throttle body intake tube.
14. Fill the cooling system.

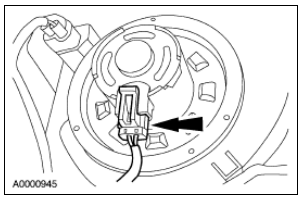
Blower Motor

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the passenger side floor duct. For additional information, refer to Section 412-01 .
3. Remove the screws and remove the cover.



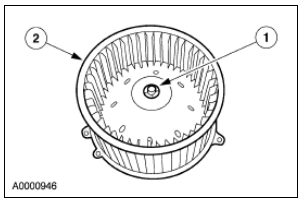
4. Disconnect the connector and remove the blower motor.



5. ⚠ **CAUTION: Prior to removing a wheel that is to be reused, clean any corrosion from the blower motor shaft to prevent damage to the wheel mounting diameter.**

   Remove the wheel from the blower motor.

   1. Remove the push clip.
   2. Remove the wheel from the blower motor.



6. **NOTE:** Make sure to install the blower motor cover. It is necessary for correct cooling.

   To install, reverse the removal procedure.

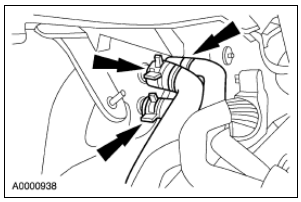
Heater Core And Evaporator Core Housing

Material

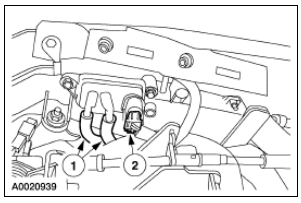
Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B
MERPOL®	ESE-M99B144-B

Removal and Installation

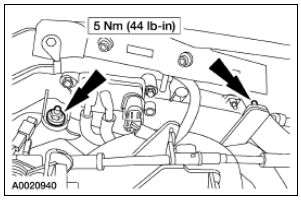
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Recover the refrigerant. For additional information, refer to Section 412-00 .
3. Partially drain the cooling system. For additional information, refer to Section 303-03 .
4. Remove the fresh air inlet duct. For additional information, refer to Section 412-01 .
5. Disconnect the heater hose assembly from the heater core.



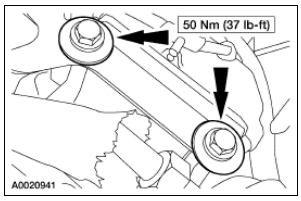
6. Disconnect the differential pressure feedback (DFPE) sensor.
    1. Disconnect the vacuum hoses.
    2. Disconnect the electrical connector.



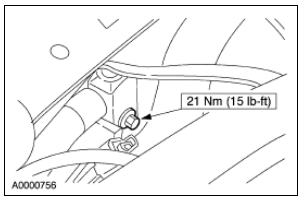
7. Remove the wire harness retaining nuts and position the wiring harness aside.



8. Remove the two harness bracket retaining bolts from the RH cylinder head and position the bracket aside.

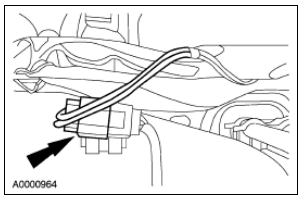


9. Remove the bolt and disconnect the manifold and tube assembly from the thermostatic expansion valve.
    - Discard the O-ring seals.

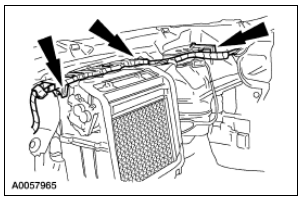


10. Remove the instrument panel. For additional information, refer to Section 501-12 .

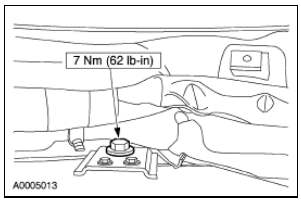
11. Disconnect the connector located on the top of the evaporator core housing.



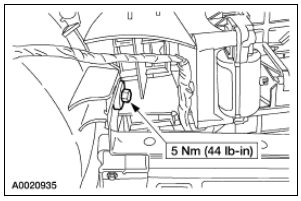
12. Detach and position the wiring harness aside.



13. Remove the cowl top attachment bolt.

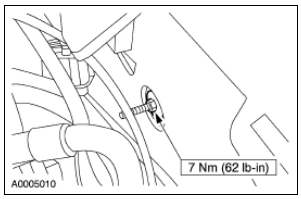


14. Remove the evaporator housing attachment bolt.

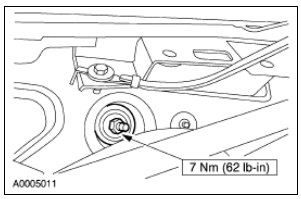


15. **NOTE:** Nut and washer assemblies removed in steps 15 and 16 are located in the engine compartment.

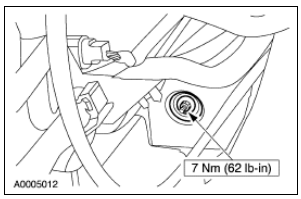
    Remove the nut and washer assembly retaining the evaporator housing to the bulkhead.



16. Remove the nut and washer assembly retaining the evaporator housing to the bulkhead.



17. Remove the nut and washer assembly retaining the evaporator housing to the bulkhead.



18. Remove the evaporator core housing.

19. To install, reverse the removal procedure.
    - Install new O-ring seals lubricated in clean PAG oil.
    - Clean and lubricate the coolant hoses with coolant hose lubricant or plain water only if needed.

20. Fill the engine coolant level. For additional information, refer to Section 303-03 .

21. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Section 412-00 .

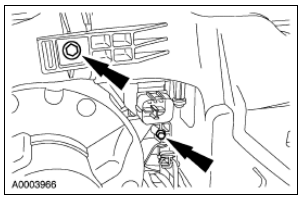
Heater Core

Removal and Installation

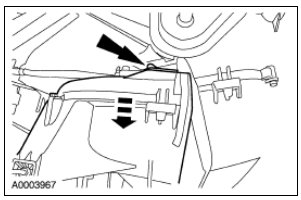
1. **NOTE:** If a leak is suspected, the heater core must be leak tested in the vehicle before removal. For additional information, refer to Section 412-00 .

   Remove the evaporator core housing. For additional information, refer to Heater Core And Evaporator Core Housing in this section.

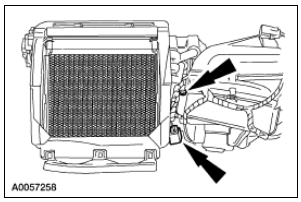
2. Remove the evaporator core housing to air inlet housing screws.



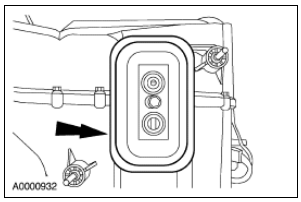
3. Disengage the clip and separate the evaporator core housing from the air inlet housing.



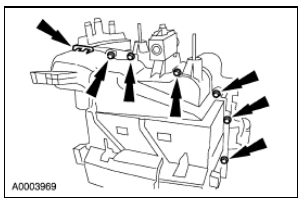
4. Disconnect the evaporator core housing electrical connectors and position the wire harness aside.



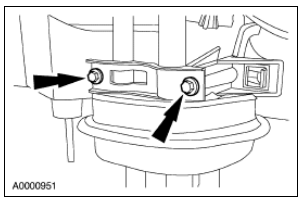
5. Remove the gasket.



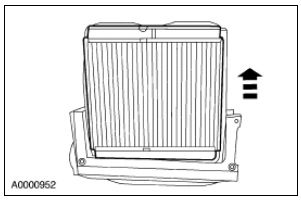
6. Remove the nine screws, disengage the clip and separate the heater core and evaporator core housing.



7. Remove the screws.



8. Remove the heater core.



9. Remove the heater core tube gasket.

10. To install, reverse the removal procedure.

Valve Dual Coolant Flow

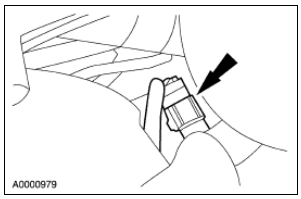
Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Drain the radiator. For additional information, refer to Section 303-03 .

3. If equipped with 3.9L engine, remove the auxiliary coolant pump. For additional information, refer to Pump Auxiliary Coolant Flow, 3.9L in this section.

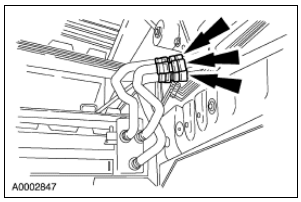
4. Disconnect the connector located at the end of the coolant valve harness pigtail.



5. **NOTE:** The top heater hose has a green identifying mark to match the hose on the dual coolant flow valve. If mark is not visible, identify the hoses for location. This will aid in the correct installation of the hose assemblies.

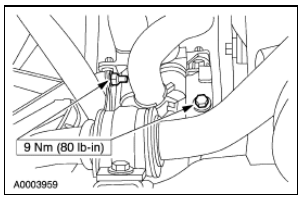
   NOTE: Hose assemblies shown with components removed for clarity.

   Disconnect the three quick-disconnect couplings from the coolant control valve hoses. For additional information, refer to Section 412-00 .



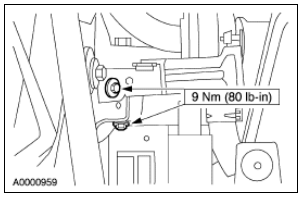
6. Raise the vehicle. For additional information, refer to Section 100-02 .

7. Remove the coolant valve assembly mounting bolt and the nut.



8. Raise the valve and disconnect the coolant supply and return lines.

9. Remove the bolts and remove the coolant valve mounting bracket.



10. To install, reverse the removal procedure.
    - Make sure that the heater hoses are installed in the correct position. For additional information, refer to Heating and Defrosting in this section.
    - Lubricate the coolant hoses with MERPOL® meeting Ford specification ESE-M99B144-B or plain water only, if needed.
    - Check for correct hose installation by verifying DATC system operation.

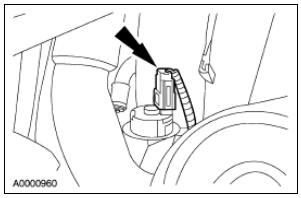
Pump Auxiliary Coolant Flow, 3.9L

Removal and Installation

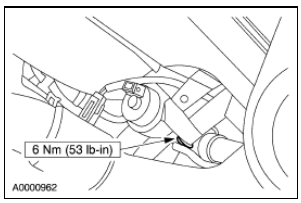
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Drain the radiator. For additional information, refer to Section 303-03 .

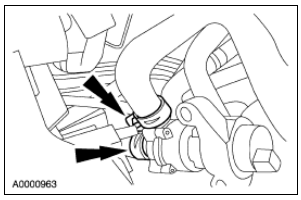
3. Disconnect the connector.



4. Remove the two auxiliary coolant pump to fan shroud bolts.



5. Disconnect the hoses and remove the pump.



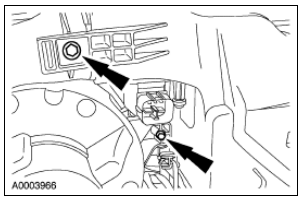
6. To install, reverse the removal procedure.
   - Make sure that the heater hoses are installed in the correct position. For additional information, refer to Heating and Defrosting in this section.
   - Lubricate the coolant hoses with MERPOL® meeting Ford specification ESE-M99B144-B or plain water only, if needed.
   - Check for correct hose installation by verifying DATC system operation.

Heater Core And Evaporator Core Housing

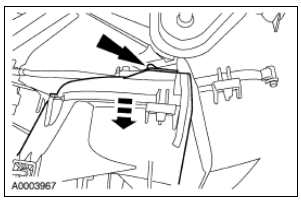
Disassembly and Assembly

1. Remove the evaporator core housing. For additional information, refer to Heater Core And Evaporator Core Housing in this section.

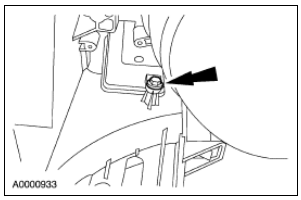
2. Remove the evaporator core housing to air inlet housing screws.



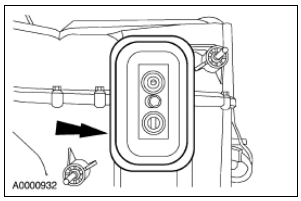
3. Disengage the clip and separate the evaporator core housing from the air inlet housing.



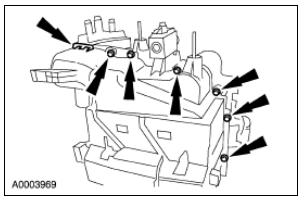
4. Remove the screw and remove the blower motor speed control.



5. Remove the gasket.



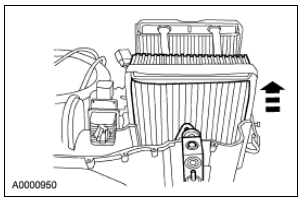
6. Remove the nine screws, disengage the clip and separate the housing.



7. If necessary, remove the cold air bypass door actuator. For additional information, refer to Section 412-04 .

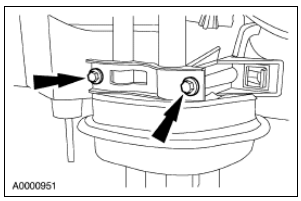
8. If necessary, remove the evaporator core air discharge temperature sensor. For additional information, refer to Section 412-04 .

9. Remove the evaporator core.

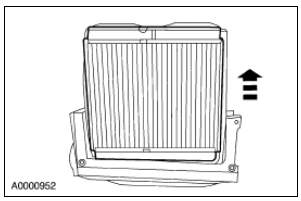


10. Disconnect the air bypass door actuator connector and position the harness aside.

11. Remove the screws.



12. Remove the heater core.



13. Remove the blower motor. For additional information, refer to Blower Motor in this section.

14. If necessary, remove the air inlet door actuator. For additional information, refer to Section 412-04 .

15. To assemble, reverse the disassembly procedure.

General Specifications

Item	Specification
Magnetic Clutch	
Air gap between pulley and clutch plate	0.35-0.75 mm (0.014-0.030 in)
Lubricants	
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B
MERPOL®	ESE-M99B144-B

Torque Specifications

Description	Nm	lb-ft	lb-in
A/C compressor mounting bolts	25	18	
A/C compressor manifold and tube retaining bolt	21	15	
A/C compressor clutch retaining nut	17	13	
A/C condenser core mounting bolts	10		89
Receiver drier mounting bracket clamp bolt	7		62
A/C pressure transducer	10		89
A/C pressure relief valve	9		80
Peanut fitting retaining nut	8		71
Thermostatic expansion valve fitting nut	9		80
Electrical harness bracket bolts	9		80
A/C compressor manifold and tube assembly bracket nut	12	9	
A/C compressor mounting bracket bolts	50	37	
TXV fittings	24	18	
Refrigerant line bracket bolt	9		80
TXV mounting bolt	21	15	
Receiver drier manifold nut	8		71

Air Conditioning

The A/C refrigerant system is a clutch cycling, thermostatic expansion valve type. The system components are:

- A/C compressor
- A/C clutch
- A/C condenser core
- A/C evaporator core
- thermostatic expansion valve
- receiver drier
- connecting refrigerant lines

The refrigeration system operation is controlled by the:

- thermostatic expansion valve.
- evaporator discharge temperature sensor.
- A/C compressor pressure relief valve.
- A/C pressure transducer.
- powertrain control module (PCM).
- DATC module.
- ambient temperature sensor.

The refrigerant system incorporates a variable capacity A/C compressor. The A/C compressor clutch engagement is controlled by the vehicle PCM.

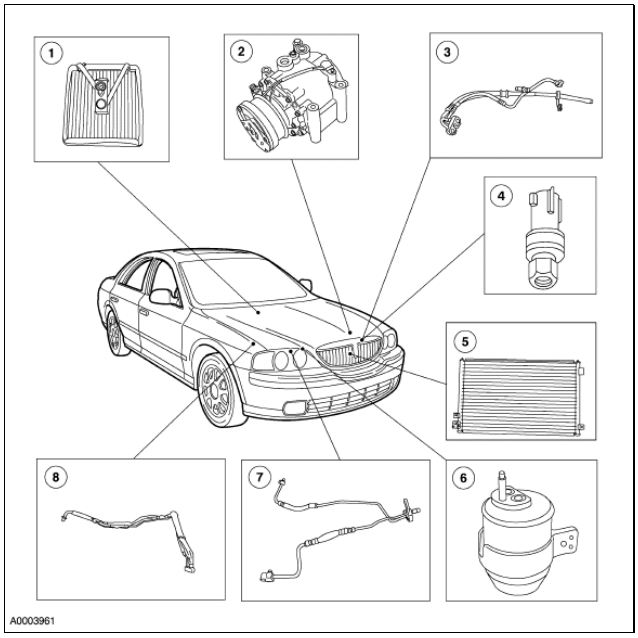
The evaporator discharge temperature sensor senses evaporator discharge temperature. The DATC module monitors the evaporator discharge temperature sensor and communicates with the PCM to control clutch cycling. The DATC also monitors the ambient air temperature sensor and disables A/C operation when the ambient air temperature is below 0°C (32°F).

The A/C pressure transducer is located in the compressor discharge line and is monitored by the PCM. If high or low refrigerant pressures are experienced, the PCM will interrupt A/C compressor operation.

The pressure relief valve is installed in the compressor manifold and tube assembly and protects the system from excessively high refrigerant pressure.

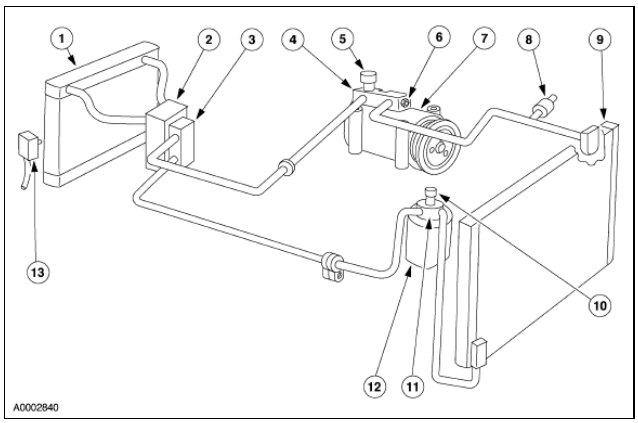
The thermostatic expansion valve, which is mounted to the evaporator core inlet and outlet tubes, contains an adjustable orifice which provides the restriction that separates the high and low pressure liquid phases in the refrigeration system.

Component Locations



Item	Part Number	Description
1	19860	A/C evaporator core
2	19D629	A/C compressor and clutch assembly
3	19D850	Manifold and tube assembly A/C compressor
4	19D594	A/C pressure transducer
5	19712	A/C condenser core
6	19959	Receiver drier
7	19N585	Manifold and tube assembly receiver drier
8	19A834	Manifold and tube assembly thermal expansion valve

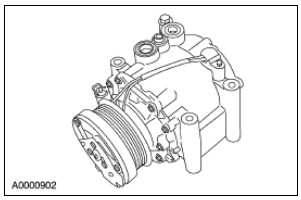
Refrigeration System Components



Item	Part Number	Description
1	19860	A/C evaporator core
2	19849	Thermostatic expansion valve
3	19A834	Manifold and tube assembly thermostatic expansion valve
4	19D850	Manifold and tube assembly A/C compressor
5	19E762	A/C charge port valve (low side)

6	19E762	A/C pressure relief valve
7	19703	A/C compressor
8	19D594	A/C pressure transducer
9	19712	A/C condenser core
10	19D701	A/C charge port valve (high side)
11	19N585	Manifold and tube assembly receiver drier
12	19959	Receiver drier
13	19C734	Sensor evaporator air discharge temperature

A/C Compressor and Clutch Assembly



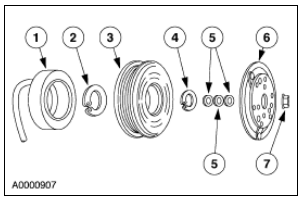
NOTE: Internal A/C compressor components are not serviced separately. The A/C scroll compressor is serviced only as an assembly. The A/C clutch, A/C clutch pulley and the A/C clutch field coil are serviceable.

The Ford Variable Scroll A/C compressor (SC90V) has the following characteristics:

- A variable capacity function controlled by a suction pressure sensing device.
- A fixed and orbiting scroll to provide refrigerant compression.
- A non-serviceable shaft seal.
- The A/C compressor uses PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B. This oil contains special additives necessary for the A/C compressor.

The A/C compressor contains a thermal cutout switch which senses the compressor housing temperature. The switch will disengage the A/C compressor clutch if the housing temperature exceeds 120°C (247°F).

SC90V A/C compressors used on the six and eight cylinder engines are not interchangeable.



Item	Part Number	Description
1	19D798	A/C clutch field coil
2	W704579-S301	Field coil snap ring
3	19D784	A/C clutch pulley
4	W701742-S301	Pulley snap ring
5	19D648	A/C clutch hub spacer
6	19D786	A/C clutch
7	W704577-S301	A/C clutch nut

The SC90V magnetic A/C clutch has the following characteristics:

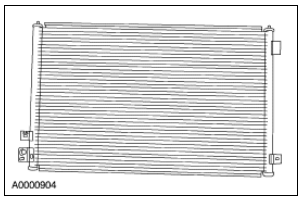
- It drives the compressor shaft.
- When battery positive voltage (B+) is applied to the A/C clutch field coil, the clutch disc and hub assembly is drawn toward the A/C clutch pulley.
- The magnetic force locks the clutch disc and hub assembly and the A/C clutch pulley together as one unit, causing the compressor shaft to rotate.
- When B+ is removed from the A/C clutch field coil, springs in the clutch disc and hub assembly move the clutch disc away from the A/C clutch pulley.

A/C Compressor Pressure Relief Valve

An A/C compressor pressure relief valve is incorporated into the compressor A/C manifold and tube to:

- relieve unusually high refrigerant system discharge pressure buildups. For specifications regarding operating pressure(s), refer to Section 412-00 .
- prevent damage to the A/C compressor and other system components.
- avoid total refrigerant loss by closing after the excessive pressure has been relieved.

A/C Condenser Core



The A/C condenser core has the following characteristics:

- It is an aluminum fin and tube design heat exchanger located in front of the vehicle radiator (8005).
- It cools compressed refrigerant gas by allowing air to pass over fins and tubes to extract heat and by condensing gas to liquid refrigerant as it is cooled.

Refrigerant Lines

The manifold and tube assembly-receiver drier carries the high pressure liquid from the condenser core to the receiver drier, and from the receiver drier to the manifold and tube assembly-thermostatic expansion valve. It attaches to the A/C receiver drier, uses O-ring seals, and also contains the high pressure service port.

The manifold and tube assembly-thermostatic expansion valve carries high pressure liquid to the thermostatic expansion valve and low pressure gas from the thermostatic expansion valve to the manifold and tube assembly-A/C compressor.

The manifold and tube assembly-A/C compressor carries the high pressure gas from the A/C compressor to the condenser core. It also carries the low pressure gas received from the manifold and tube assembly-thermostatic expansion valve to the A/C compressor. The A/C manifold and tube assembly is attached to the A/C compressor, uses O-ring seals, and has:

- a Schrader-type valve stem core fitting used to mount the A/C pressure transducer so that the A/C pressure transducer can be removed without discharging the A/C system.
- a serviceable high pressure relief valve.

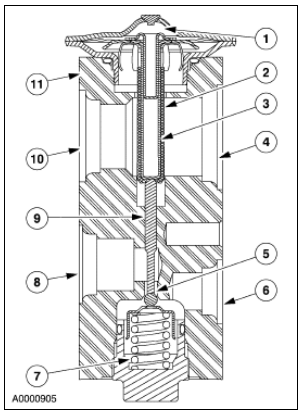
The manifold and tube assembly-A/C compressor used on the V6 and V8 engines are not interchangeable.

A/C Evaporator Core

The A/C evaporator core is the plate/fin type with a unique refrigerant flow path.

- A mixture of refrigerant and oil exits the thermostatic expansion valve (TXV) and enters the evaporator tank area through the 1/2 inch (12.7 mm) tube.
- The tank area is divided into three sections: front inlet, front outlet and rear tank.
- The refrigerant enters the evaporator core tank area at the front inlet, flows down through the core and up the back side in a "U-flow" pattern.
- The refrigerant moves into the rear tank area and across to the other half of the core. The refrigerant moves down through the core and back up the front side of the core to the front outlet tank area.
- The refrigerant at this point is in a gaseous state. It exits the evaporator through the 5/8 inch (15.9 mm) tube then passes through the TXV.

A/C Thermostatic Expansion Valve



Item	Description
1	Sensing bulb
2	Insulator
3	Hollow core pin-type retainer
4	Outlet port low pressure liquid
5	Metering orifice
6	Inlet port high pressure liquid
7	Spring
8	Evaporator inlet port low pressure liquid
9	Pin
10	Evaporator outlet port low pressure gas
11	Housing

The thermostatic expansion valve has the following characteristics:

- It is mounted on the A/C evaporator core inlet and outlet tubes.
- It is a block-type valve.
- It contains an internal sensing bulb to increase the effectiveness of temperature sensing.
- It is not serviceable. A new thermostatic expansion valve must be installed as a unit.

Receiver Drier

The receiver drier is mounted to the engine fan shroud to the right of the vehicle center. The inlet tube of the receiver drier attaches directly to the A/C condenser core and the outlet tube of the receiver drier attaches to the thermostatic expansion valve inlet line.

The receiver drier stores high pressure liquid after it leaves the condenser core. A desiccant bag mounted in the receiver drier removes any retained moisture.

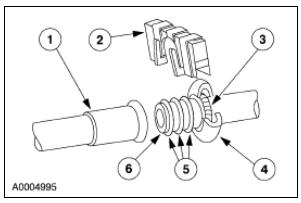
The manifold and tube assembly that mounts to the top of the receiver drier contains the high pressure service port for the refrigerant system.

A/C Pressure Transducer

The A/C pressure transducer monitors the compressor discharge pressure and communicates with the powertrain control module (PCM). The PCM will interrupt A/C compressor operation in the event that the A/C pressure transducer indicates high system discharge pressures. It is also used to sense no or low charge conditions. If the pressure is below a predetermined value for a given ambient temperature, the PCM will not allow the clutch to engage.

- The A/C pressure transducer is mounted on a Schrader valve-type fitting on the A/C compressor to condenser discharge line.
- A valve depressor, located inside the threaded end of the A/C pressure transducer, presses on the Schrader valve stem and allows the A/C pressure transducer to monitor the compressor discharge pressure.
- When the compressor discharge pressure rises, the PCM will interrupt the A/C compressor clutch coil circuit and disengage the A/C compressor. When the pressure drops, the PCM will enable the A/C compressor circuit. For specifications regarding operating pressure(s), refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
- It is not necessary to discharge the refrigerant system to remove the A/C pressure cut-off switch.

Spring Lock Coupling



Item	Part Number	Description
1		Female fitting
2	19E746	A/C tube lock coupling clip
3	19E576	A/C tube lock coupling spring
4		Cage
5		O-ring seals
6		Male fitting

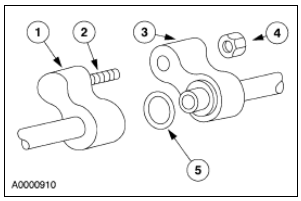
The spring lock coupling is a refrigerant line coupling held together by a garter spring inside a circular cage. The spring lock coupling is used to connect the A/C compressor manifold and tube assembly (inlet) to the TXV manifold and tube assembly (outlet).

- When the coupling is connected together, the flared end of the female fitting slips behind the garter spring inside the cage of the male fitting.
- The garter spring and cage then prevent the flared end of the female fitting from pulling out of the cage.
- Three O-ring seals are used to seal between the thermostatic expansion valve outlet tube and the compressor inlet tube. All other couplings have two O-ring seals.
- Use only the O-ring seals listed in the Ford Master Parts Catalog for the spring lock coupling.
- An A/C tube lock coupling clip is used to secure the coupling.

Peanut Fitting

The A/C condenser core and the connection between the receiver drier manifold assembly (outlet) and the TXV manifold and tube assembly (inlet) use the peanut-shaped refrigerant fittings instead of spring lock couplings.

- The male and female blocks of the peanut fitting are retained with a nut.
- An O-ring seal is installed around the tube on the male block.
- When correctly assembled, the male and female fittings should be flush.
- Use only the O-ring seals listed in the Ford Master Parts Catalog for the peanut fitting.

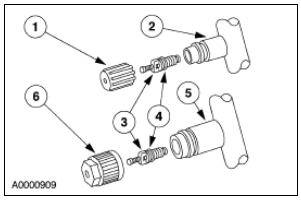


Item	Part Number	Description
1		Female block (part of tube assembly)
2	W701890-S426	Stud (part of female block)
3		Male block (part of 19712)
4	W520413-S301	Nut
5		O-ring seal

Service Gauge Port Valves

The high-pressure service gauge port valve is located on the A/C receiver drier manifold and tube assembly.

The low pressure service gauge port valve is located on the manifold of the A/C compressor manifold and tube assembly at the A/C compressor.



Item	Part Number	Description
1	19D702	A/C charging valve cap
2		Low pressure service gauge port valve
3	19D701	Schrader-type valve

4		O-ring seal (part of 19D701)
5		High pressure service gauge port valve
6	19D702	A/C charging valve cap

The fitting is an integral part of the refrigeration line or component.

- Special couplings are necessary for both the high side and low side service gauge ports.
- A new Schrader-type valve core can be installed if the seal leaks.
- Always install the A/C charging valve cap on the service gauge port valves after repairing the refrigerant system.

Air Conditioning

Refer to Section 412-00 .

Air Conditioning (A/C) Compressor 3.0L

Removal and Installation

⚠ CAUTION: If installing a new air conditioning compressor due to an internal failure of the old unit, you must carry out the following procedures to remove contamination from the air conditioning system.

- If A/C flushing equipment is available, carry out the flushing of the air conditioning system prior to installing a new air conditioning compressor. For additional information, refer to Section 412-00 .
- If A/C flushing equipment is not available, carry out filtering of the air conditioning system after a new air conditioning compressor has been installed. For additional information, refer to Section 412-00 .
- Install a new thermostatic expansion valve, as directed by the A/C flushing or filtering procedure.
- Install a new receiver/drier, as directed by the A/C flushing or filtering procedure.

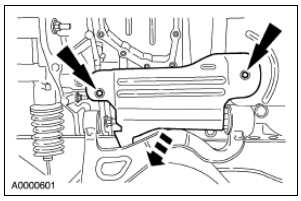
NOTE: Installation of a new receiver/drier is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the suction accumulator.

1. If flushing of the air conditioning system has not been performed, recover the refrigerant. For additional information, refer to Section 412-00 .

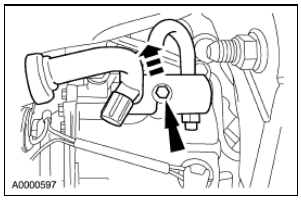
2. Remove the drive belt from the A/C clutch pulley.

3. Raise the vehicle. For additional information, refer to Section 100-02 .

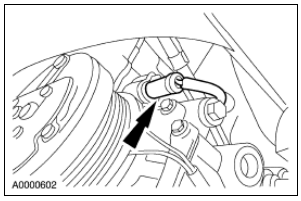
4. Remove the screws and remove the sight shield.



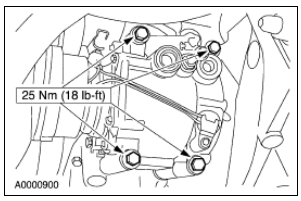
5. Remove the bolt and reposition the A/C manifold and tube assembly.



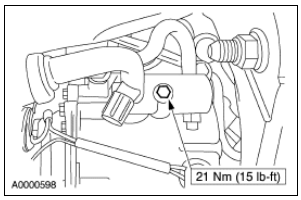
6. Disconnect the connector.



7. Remove the bolts and lower the A/C compressor.



8. To install, reverse the removal procedure.
    - If filtering of the refrigerant system is not to be performed, add the correct amount of PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B to the new A/C compressor. For additional information, refer to Section 412-00 .
    - Lubricate the O-ring seal with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.



9. If filtering of the refrigerant system is not to be performed, evacuate, charge and leak test the refrigerant system. For additional information, refer to Section 412-00 .

Air Conditioning (A/C) Compressor 3.9L

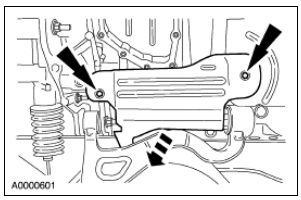
Removal and Installation

⚠ CAUTION: If installing a new air conditioning compressor due to an internal failure of the old unit, you must carry out the following procedures to remove contamination from the air conditioning system.

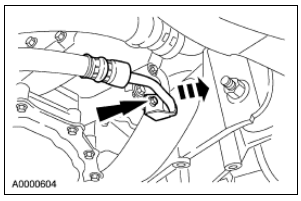
- If A/C flushing equipment is available, carry out the flushing of the air conditioning system prior to installing a new air conditioning compressor. For additional information, refer to Section 412-00 .
- If A/C flushing equipment is not available, carry out filtering of the air conditioning system after a new air conditioning compressor has been installed. For additional information, refer to Section 412-00 .
- Install a new thermostatic expansion valve, as directed by the A/C flushing or filtering procedure.
- Install a new receiver/drier, as directed by the A/C flushing or filtering procedure.

NOTE: Installation of a new receiver/drier is not required when repairing the air conditioning system except when there is physical evidence of system contamination from a failed A/C compressor or damage to the suction accumulator.

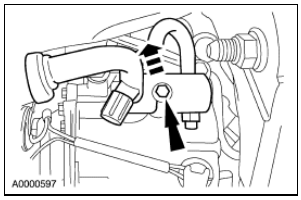
1. If flushing of the air conditioning system has not been performed, recover the refrigerant. For additional information, refer to Section 412-00 .
2. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
3. Remove the drive belt from the A/C clutch pulley.
4. Raise the vehicle. For additional information, refer to Section 100-02 .
5. Remove the screws and remove the sight shield.



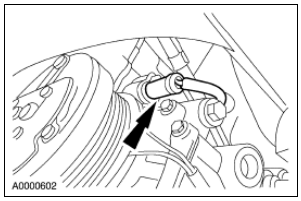
6. Remove the screw and position the power steering hose aside.



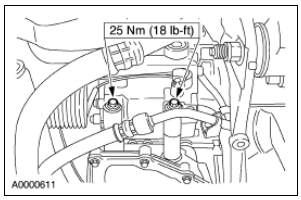
7. Remove the bolt and reposition the A/C manifold and tube assembly.



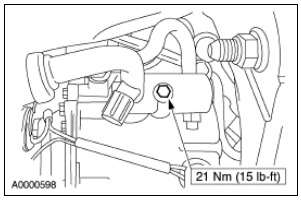
8. Disconnect the connector.



9. Remove the three bolts and lower the A/C compressor.



10. To install, reverse the removal procedure.
    - If filtering of the refrigerant system is not to be performed, add the correct amount of PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B to the new A/C compressor. For additional information, refer to Section 412-00 .
    - Lubricate the O-ring seal with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.

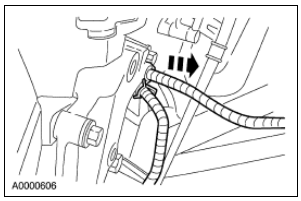


Air Conditioning (A/C) Compressor Bracket 3.0L

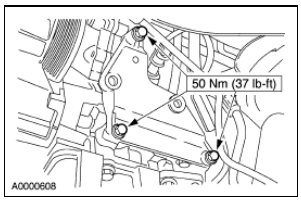
Removal and Installation

1. Remove the A/C compressor. For additional information, refer to Air Conditioning (A/C) Compressor 3.0L in this section.

2. Disengage the wire harness pin-type retainer.



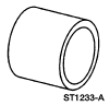
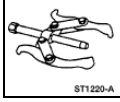
3. Remove the bolts and remove the bracket.



4. To install, reverse the removal procedure.

Clutch and Clutch Field Coil

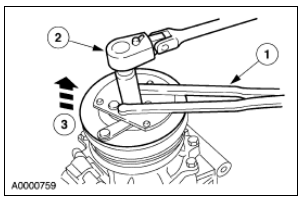
Special Tool(s)

 ST1233-A	Installer, A/C Compressor Clutch Pulley 412-109 (T97P-19D786-A)
 ST1220-A	Remover, Differential Bearing 205-116 (T77F-4220-B1)

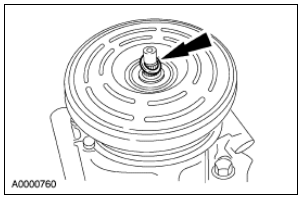
Removal

1. Remove the A/C compressor. For additional information, refer to Air Conditioning (A/C) Compressor - 3.0L or Air Conditioning (A/C) Compressor - 3.9L in this section.

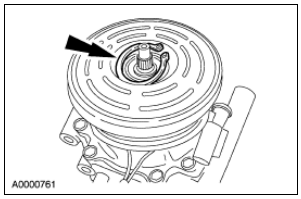
2. Remove the A/C clutch.
    1. Hold the A/C clutch hub.
    2. Remove the nut.
    3. Remove the A/C disk and hub.



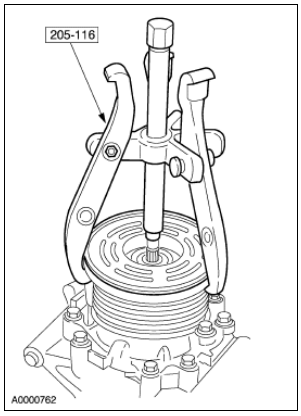
3. Remove the spacer.



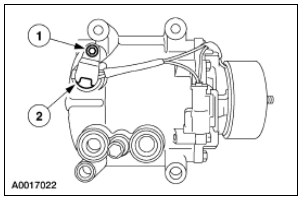
4. Remove the pulley snap ring.



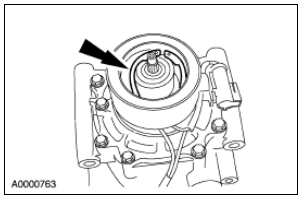
5. Using the special tool, remove the A/C clutch pulley.



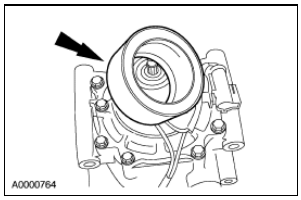
6. Remove the sensor.
    1. Remove the bolt and the hold-down bracket.
    2. Lift out the sensor while lightly twisting and pulling up on the sensor.
    - It may be necessary to pry up lightly with a small screwdriver.



7. Remove the field coil snap ring.



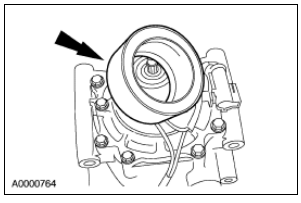
8. Remove the A/C clutch field coil.



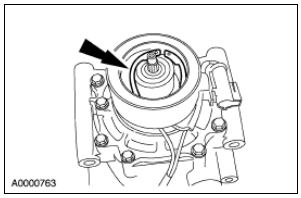
Installation

1. Clean the A/C clutch field coil and pulley mounting surfaces.

2. Install the A/C clutch field coil.



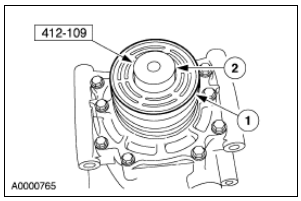
3. Install the snap ring with the bevel side out.



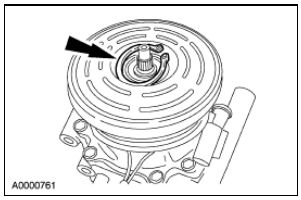
4. **NOTE:** The A/C clutch bearing and pulley is a slip fit on the compressor. If correctly aligned it should slip on easily. If difficulty is encountered, install using the special tool.

   Using the special tool, install the clutch bearing and pulley.

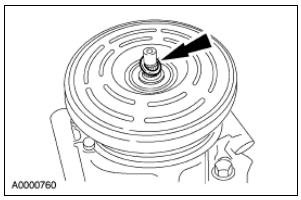
   1. Position the clutch bearing and pulley.
   2. Install the special tool. If required, gently tap and install the clutch bearing and pulley.



5. Install the snap ring with the bevel side out.

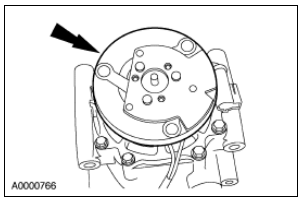


6. Install the spacer.

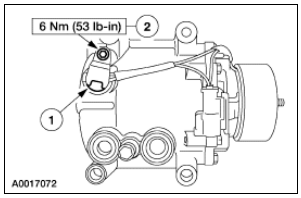


7. **NOTE:** Make sure to align the block tooth on the shaft with the missing tooth on the disc and hub.

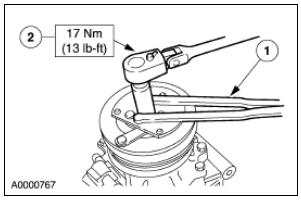
   Install the A/C clutch.



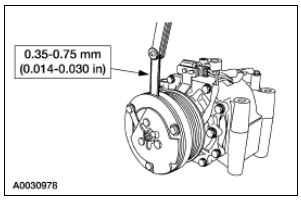
8. Install the sensor.
   1. Push the sensor into position.
   2. Install the bolt and the hold-down bracket.



9. Install the bolt.
    1. Hold the A/C clutch.
    2. Install the bolt.



10. Measure and adjust the clutch air gap by removing or adding A/C clutch hub spacers.



11. Install the A/C compressor. For additional information, refer to Air Conditioning (A/C) Compressor - 3.0L or Air Conditioning (A/C) Compressor - 3.9L in this section.

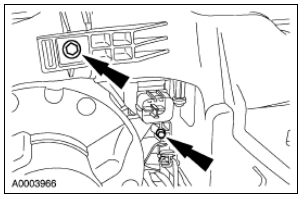
Evaporator Core

Removal and Installation

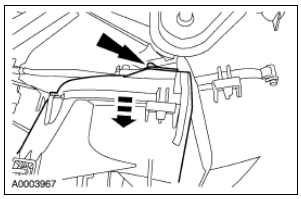
NOTE: If an A/C evaporator core leak is suspected the A/C evaporator core must be leak tested before it is removed from the vehicle. For additional information, refer to Section 412-00 .

1. Remove the evaporator core housing. For additional information, refer to Section 412-02 .

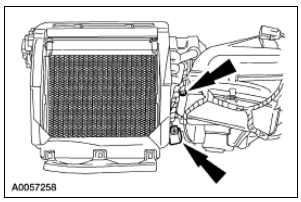
2. Remove the screws which connect the air inlet housing to the evaporator housing.



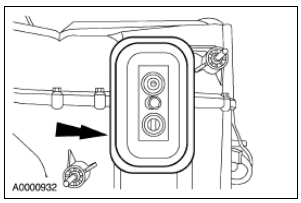
3. Disengage the clip and separate the housings.



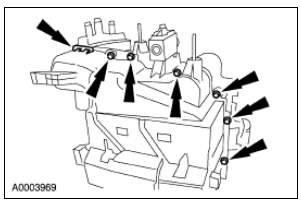
4. Disconnect the evaporator core housing wire harness connectors and position the wire harness aside.



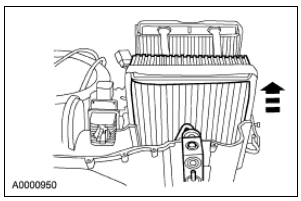
5. Remove the gasket.



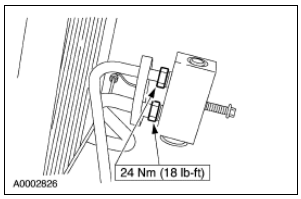
6. Remove the nine screws, disengage the clip and separate the heater/evaporator core housing.



7. Remove the evaporator core.



8. Disconnect the fittings and remove the thermostatic expansion valve.

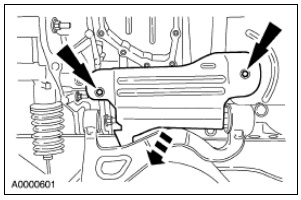


9. To install, reverse the removal procedure.
    - Lubricate the O-ring seal with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.
    - Add the correct amount of PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B to the new A/C evaporator core. For additional information, refer to Section 412-00 .

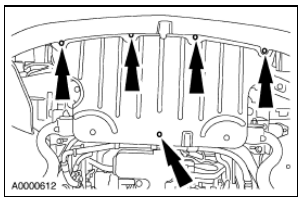
Receiver Drier

Removal and Installation

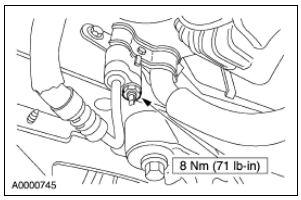
1. Recover the refrigerant. For additional information, refer to Section 412-00 .
2. Raise the vehicle. For additional information, refer to Section 100-02 .
3. Remove the screws and remove the LH sight shield.



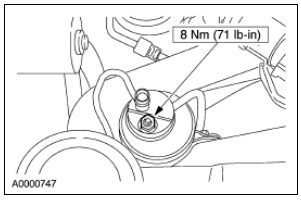
4. Remove the screws and remove the air deflector.



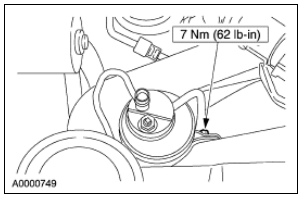
5. Remove the nut and disconnect the peanut fitting. For additional information, refer to Section 412-00 .



6. Lower the vehicle.
7. Disconnect the air outlet tube. For additional information, refer to Section 303-12 .
8. Remove the nut.



9. Remove the bolt. Position the receiver drier away from the radiator shroud and disconnect the receiver drier from the manifold.



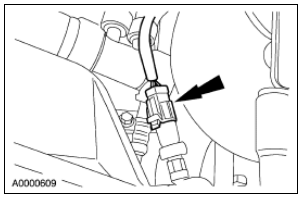
10. To install, reverse the removal procedure.
    - Lubricate the O-ring seal with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.

Air Conditioning (A/C) Pressure Transducer

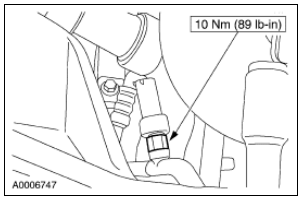
Removal and Installation

1. Disconnect the battery. For additional information, refer to Section 414-01 .

2. Disconnect the connector.



3. Remove the pressure transducer.



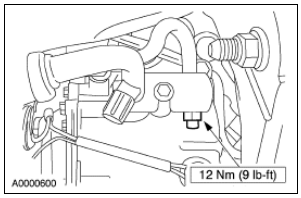
4. To install, reverse the removal procedure.
    - Lubricate the O-ring seal with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.

Air Conditioning (A/C) Pressure Relief Valve

Removal and Installation

1. Recover the refrigerant. For additional information, refer to Section 412-00 .

2. Remove the A/C compressor pressure relief valve (3.0L shown, 3.9L similar).



3. To install, reverse the removal procedure.
   - Lubricate the O-ring seal with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.

Condenser Core

Material

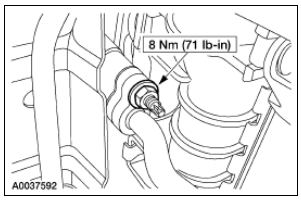
Item	Specification
PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C)	WSH-M1C231-B

Removal and Installation

NOTE: If an A/C condenser core leak is suspected, the A/C condenser core must be leak tested before it is removed from the vehicle. For additional information, refer to Section 412-00 .

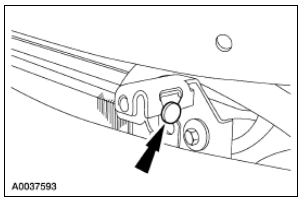
NOTE: Installation of a new receiver/drier is not required when repairing the air conditioning system except when there is physical evidence of contamination from a failed A/C compressor or damage to the receiver drier.

1. Recover the refrigerant. For additional information, refer to Section 412-00 .
2. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
3. Remove the upper radiator sight shield.
4. Remove the nut and disconnect the condenser inlet fitting.

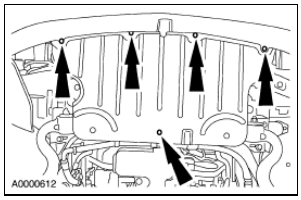


5. **NOTE:** LH condenser bracket pin-type retainer shown, RH similar.

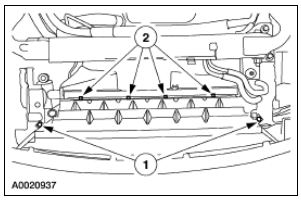
   Remove the RH and LH upper condenser bracket pin-type retainers.



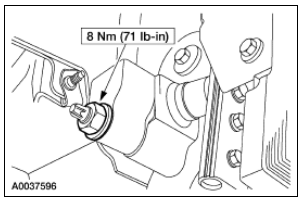
6. Raise and support the vehicle. For additional information, refer to Section 100-02 .
7. Remove the screws and remove the air deflector.



8. Remove the air deflector.
    1. Remove the pin-type retainers.
    2. Remove the side-clip retainers.

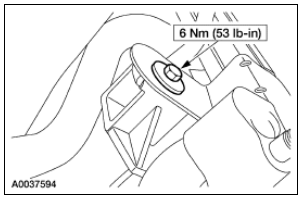


9. Remove the nut and disconnect the condenser outlet fitting.

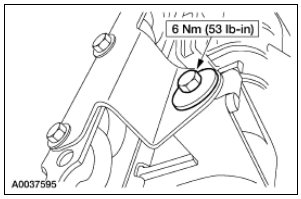


10. ⚠ **CAUTION: To avoid damage to the condenser core, correctly support the condenser when removing the lower mounting bolts.**

    Remove the LH bolt.



11. Remove the RH bolt and lower the condenser core.



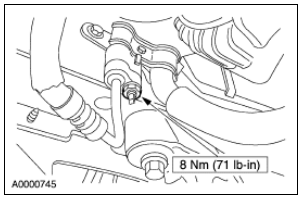
12. To install, reverse the removal procedure.
    - Install new O-ring seals lubricated in clean PAG oil.
    - Lubricate the refrigerant system with the correct amount of clean PAG oil. For additional information, refer to Section 412-00 .

Receiver Drier Manifold and Tube Assembly 3.0L

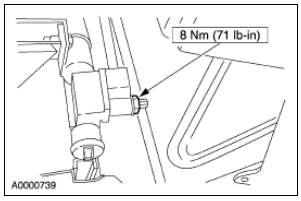
Removal and Installation

1. Recover the refrigerant. For additional information, refer to Section 412-00 .

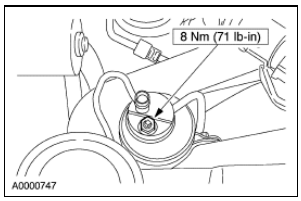
2. Disconnect the peanut fitting. For additional information, refer to Section 412-00 .



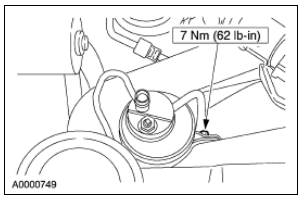
3. Disconnect the peanut fitting. For additional information, refer to Section 412-00 .



4. Remove the nut.



5. Remove the receiver drier mounting bracket clamp bolt. Move the receiver drier away from the fan shroud and remove the receiver drier.



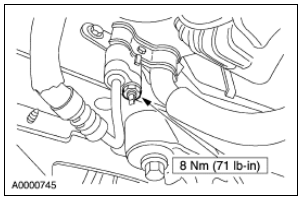
6. Remove the receiver drier manifold assembly.

7. To install, reverse the removal procedure.
   - Lubricate the O-ring seal with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.

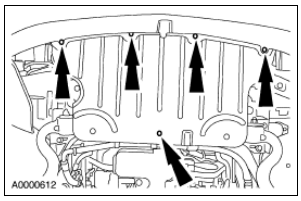
Receiver Drier Manifold and Tube Assembly 3.9L

Removal and Installation

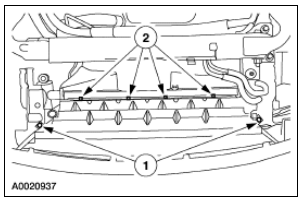
1. Recover the refrigerant. For additional information, refer to Section 412-00 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Disconnect the peanut fitting. For additional information, refer to Section 412-00 .



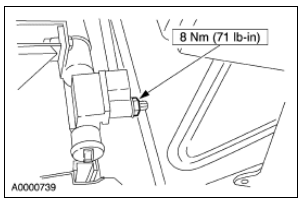
4. Remove the screws and remove the air deflector.



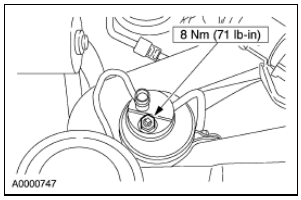
5. Remove the air deflector.
    1. Remove the push-pin retainers.
    2. Remove the side-clip retainers.



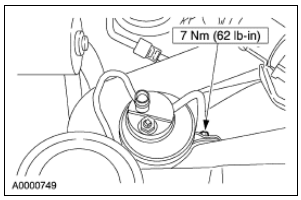
6. Disconnect the peanut fitting. For additional information, refer to Section 412-00 .



7. Lower the vehicle.
8. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
9. Remove the nut.



10. Remove the receiver drier mounting bracket clamp bolt. Move the receiver drier away from the fan shroud and remove the receiver drier.



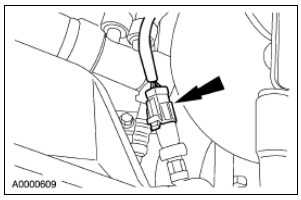
11. Remove the receiver drier manifold assembly.

12. To install, reverse the removal procedure.
    - Lubricate the O-ring seal with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.

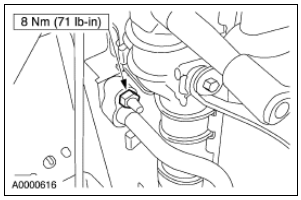
Compressor Manifold and Tube Assembly

Removal and Installation

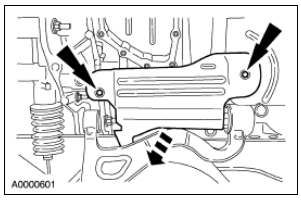
1. Disconnect the battery. For additional information, refer to Section 414-01 .
2. Recover the refrigerant. For additional information, refer to Section 412-00 .
3. Disconnect the air outlet tube and position aside. For additional information, refer to Section 303-12 .
4. Disconnect the connector.



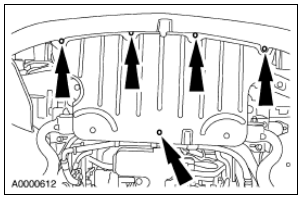
5. Remove the nut and disconnect the peanut fitting. For additional information, refer to Section 412-00 .



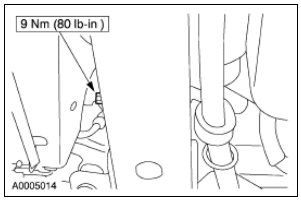
6. Raise the vehicle. For additional information, refer to Section 100-02 .
7. Remove the screws and remove the LH and RH sight shields (LH shown, RH similar).



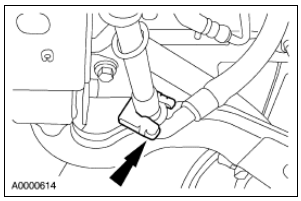
8. Remove the screws and remove the air deflector.



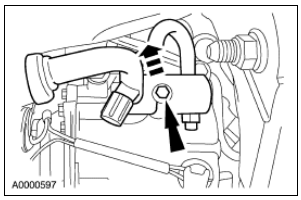
9. Remove the refrigerant line bracket bolt.



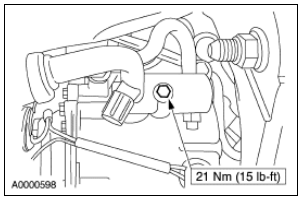
10. Disconnect the spring lock coupling. For additional information, refer to Section 412-00 .



11. Loosen the bolt and remove the A/C compressor manifold and tube assembly.



12. To install, reverse the removal procedure.
    - Lubricate the O-ring seal with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.



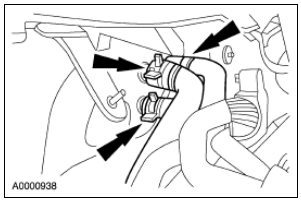
Thermostatic Expansion Valve Manifold and Tube Assembly 3.0L

Removal and Installation

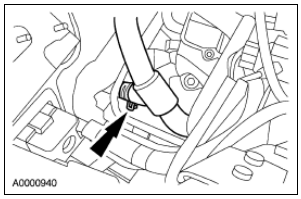
1. Recover the refrigerant. For additional information, refer to Section 412-00 .

2. Remove the cabin air filter plenum. For additional information refer to Section 412-01 .

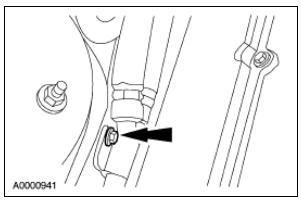
3. Disconnect the heater hoses from the heater core.



4. Disconnect the coolant recovery line.



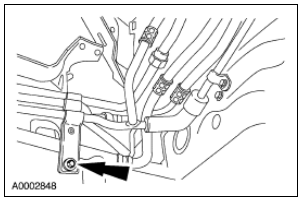
5. Remove the forward heater hose mounting bolt at the RH shock tower.



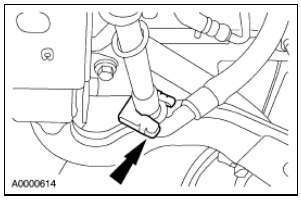
6. Raise the vehicle. For additional information refer to Section 100-02 .

7. **NOTE:** Shown with components removed for clarity.

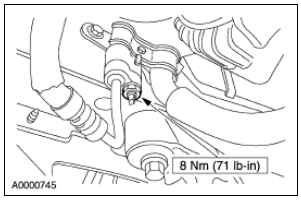
   Remove the rear heater hose mounting bolt from the body side and position the heater hose assembly aside.



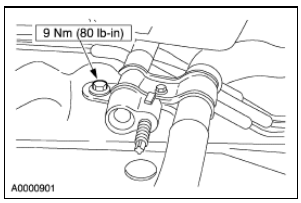
8. Disconnect the spring lock coupling. For additional information, refer to Section 412-00 .



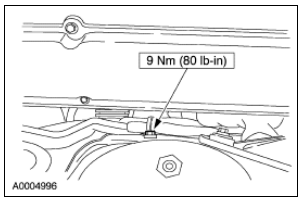
9. Remove the nut and disconnect the peanut fitting. For additional information, refer to Section 412-00 .



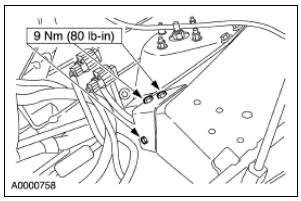
10. Remove the refrigerant line bracket bolt.



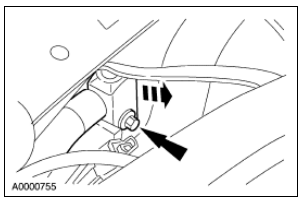
11. Remove the refrigerant line bracket bolt.



12. Remove the refrigerant line bracket bolts and position the bracket aside.

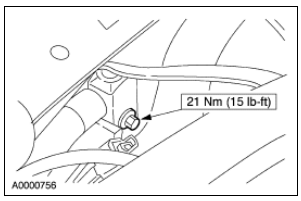


13. Loosen the bolt and remove the thermostatic expansion valve manifold and tube assembly.



14. To install, reverse the removal procedure.
    - Lubricate the O-ring seal with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.
    - Make sure that the heater hoses are connected correctly to the heater core. For additional information refer to Section 412-02 .

- Lubricate the coolant hoses with MERPOL® or plain water, if needed.



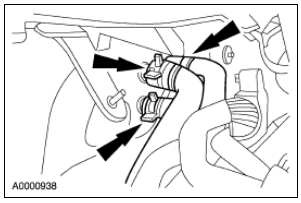
Thermostatic Expansion Valve Manifold and Tube Assembly 3.9L

Removal and Installation

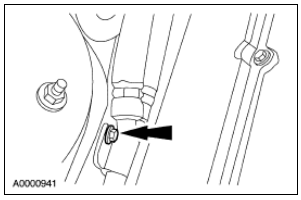
1. Recover the refrigerant. For additional information, refer to Section 412-00 .

2. Remove the cabin air filter plenum. For additional information, refer to Section 412-01 .

3. Disconnect the heater hoses from the heater core.



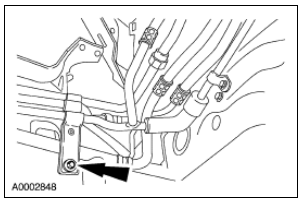
4. Remove the forward heater hose mounting bolt at the RH shock tower.



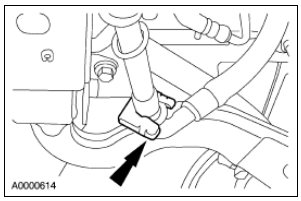
5. Raise and support the vehicle. For additional information, refer to Section 100-02 .

6. **NOTE:** Shown with components removed for clarity.

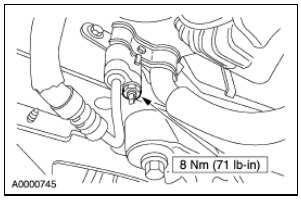
   Remove the rear heater hose mounting bolt from the body side and position the heater hose assembly aside.



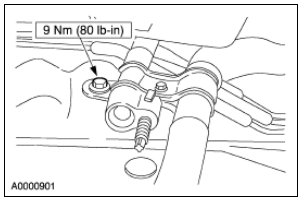
7. Disconnect the spring lock coupling. For additional information, refer to Section 412-00 .



8. Remove the nut and disconnect the peanut fitting. For additional information, refer to Section 412-00 .

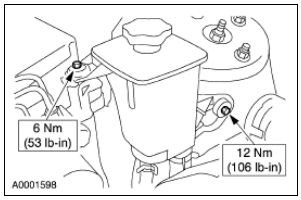


9. Remove the refrigerant line bracket bolt.

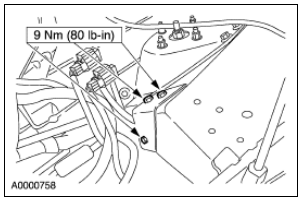


10. Lower the vehicle.

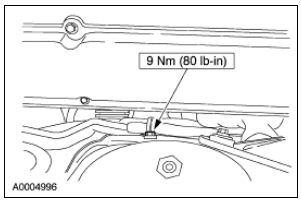
11. Loosen the two mounting bolts. Lift off and set aside the power steering reservoir.



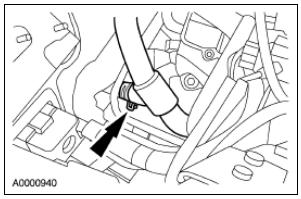
12. Remove the refrigerant line bracket bolts and position the bracket aside.



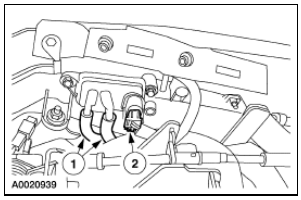
13. Remove the refrigerant line bracket bolt.



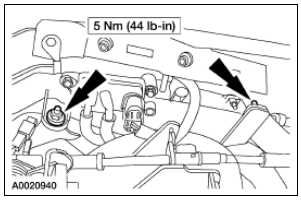
14. Disconnect the coolant recovery line.



15. Disconnect the differential pressure feedback EGR (DFPE) sensor.
    1. Disconnect vacuum hoses.
    2. Disconnect electrical connector.

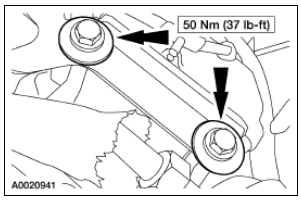


16. Remove wire harness retaining nuts and position wire harness aside.

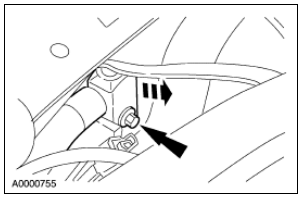


17. **NOTE:** Engine removed for clarity.

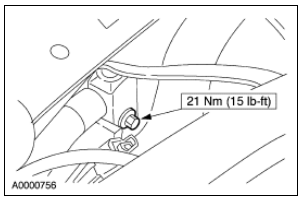
    Remove the two harness bracket retaining bolts and remove the harness bracket.



18. Loosen the bolt and remove the thermostatic expansion valve manifold and tube assembly.



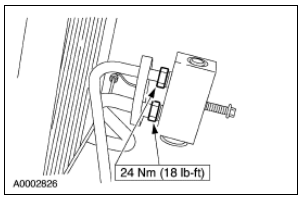
19. To install, reverse the removal procedure.
    - Lubricate the O-ring seal with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.
    - Make sure that the heater hoses are connected correctly to the heater core. For additional information, refer to Section 412-02 .
    - Lubricate the coolant hoses with MERPOL® or plain water, if needed.



Thermostatic Expansion Valve 3.9L

Removal and Installation

1. Disconnect the battery. For additional information, refer to Section 414-01 .
2. Recover the refrigerant. For additional information, refer to Section 412-00 .
3. Remove the evaporator core. For additional information, refer to Evaporator Core in this section.
4. Disconnect the thermostatic expansion valve fittings.



5. To install, reverse the removal procedure.
    - Lubricate the O-ring seals with PAG Refrigerant Compressor Oil (R-134a Systems) F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent meeting Ford specification WSH-M1C231-B.

Control Components

Dual Electronic Automatic Temperature Control

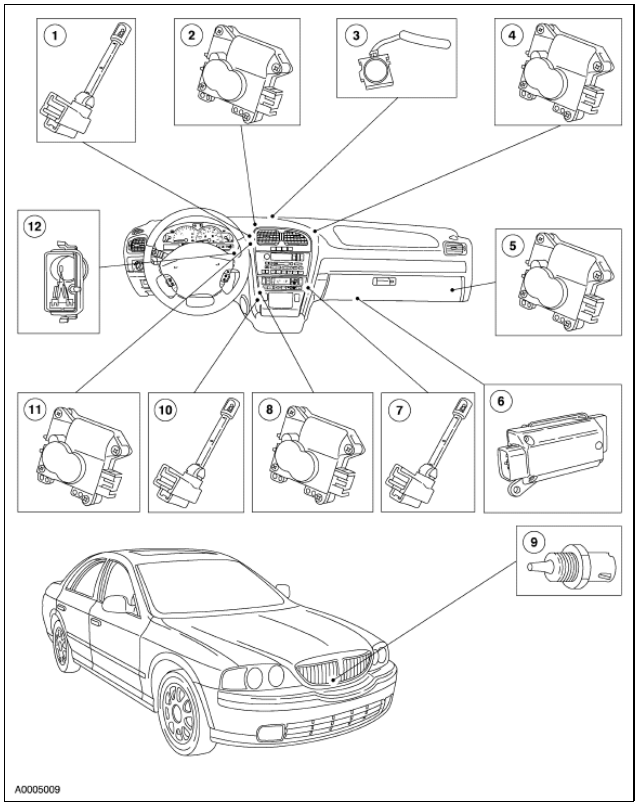
With the use of a microcontroller, the dual automatic temperature control (DATC) module analyzes input from the following major sources:

- temperature, function and blower selection (made by the vehicle occupants)
- in-vehicle temperature sensor
- ambient temperature sensor
- dual sunload sensor
- vehicle speed
- engine rpm
- engine coolant temperature
- actuator door position controls
- driver and passenger heater core air discharge temperature sensors
- evaporator discharge temperature

Using these inputs, the microcontroller determines the correct conditions for the following outputs:

- A/C clutch engagement
- blower speed
- cold air bypass door position
- panel door position
- defrost door position
- floor door position
- air inlet duct door position
- driver coolant control valve
- passenger driver coolant control valve
- electric water pump (3.9L engine)
- heater wiper rest or heated windshield
- heated rear window rear defog
- external temperature (outside temperature display)

Component Locations



Item	Part Number	Description
1	19C734	Sensor - evaporator discharge air temperature
2	19E616	Actuator - defrost duct door
3	19E663	A/C dual sunload sensor
4	19E616	Actuator - panel, center console
5	19E616	Actuator - air inlet
6	19E624	A/C blower motor speed control
7	19C734	Sensor - passenger air discharge temperature
8	19E616	Actuator - floor duct door
9	12A648	Sensor - ambient air temperature
10	19C734	Sensor - driver air discharge temperature
11	19E616	Actuator - cold air bypass door
12	19C734	Sensor - in-vehicle temperature

Control System Inputs

Climate Control Assembly

The dual automatic temperature control (DATC) module, located in the instrument panel, has the following features:

- a blower speed override control for manual input
- individual temperature set controls for driver and passenger
- an A/C request control for manual input
- a recirculated air control for manual input
- a vacuum fluorescent display for displaying set temperatures for both the driver and passenger, external or ambient temperature, blower speed setting and diagnostic trouble codes (DTCs)

- an on-board diagnostic (OBD) feature to supply the technician with diagnostic trouble codes (DTCs). These DTCs direct the technician to the inoperative component.
- air distribution mode overrides
- rear defog control
- heated wiper rest or heated windshield
- EXT temperature control to display external or outside temperature
- F/C control to toggle between English or metric settings

A/C Ambient Air Temperature Sensor

The A/C ambient air temperature sensor:

- is located in front of the A/C condenser core near the center of the vehicle.
- contains a thermistor which measures the temperature of outside air as a resistance and sends that reading to the dual automatic temperature control assembly.

In-Vehicle Temperature Sensor

The in-vehicle temperature sensor is located in the instrument cluster finish panel. The sensor operates in the following manner:

- A thermistor in the in-vehicle temperature sensor measures air temperature inside the passenger compartment.
- An automatic temperature control sensor hose is connected between the A/C plenum housing and the in-vehicle temperature sensor.
- The automatic temperature control sensor hose and venturi takes air from the A/C plenum housing to create a suction across the in-vehicle temperature sensor.
- The suction draws in-vehicle air into the in-vehicle temperature sensor and across the thermistor.

Dual A/C Sunload Sensor

The dual A/C sunload sensor:

- is located on the top center of the instrument panel in the defroster grille.
- contains photovoltaic diodes that are sensitive to sunlight.
- generates small amounts of current across the terminals depending upon the amount of light reaching the photovoltaic diode; therefore the only test that can be carried out is for an internal short circuit, an open circuit or sensor value out-of-range.
- contains an internal diagnostic resistor to allow the DATC module to detect a difference between an open circuit and no sunlight.

Control System Outputs

A/C Blower Motor Speed Control

The A/C blower motor speed control is located on the A/C evaporator housing.

- The function of the A/C blower motor speed control is to convert low power signals from the dual electronic automatic temperature control module to a high current, variable ground feed for the blower motor.
- Blower motor speed is infinitely variable and is controlled by the dual electronic automatic temperature control module software.
- A delay function provides a gradual increase or decrease in blower motor speed under all conditions.

- Controls the integral high blower relay which is engaged when maximum fan speed is selected.

A/C Electronic Air Inlet Door Actuator

The A/C electronic air inlet door actuator is located on the evaporator housing. The air inlet door position determines whether outside or recirculated air is being used.

- The actuator positions the air inlet door on command from the control assembly.
- The air inlet door actuator contains a reversible electric motor and a potentiometer.
- A 5 volt signal and ground reference is applied to the ends of the potentiometer. The voltage available at the wiper indicates the position of the potentiometer. The target position of the actuator is calculated by the DATC module and is matched with the wiper voltage of the actuator. The control module will drive the actuator motor in the direction necessary to make the actuator wiper voltage agree with the control module target position.

Cold Air Bypass Door Actuator

The cold air bypass door actuator is located on the evaporator core housing. During automatic operation the control module can position the door fully open so that some of the airflow will not pass through the heater core. This will provide for maximum cooling. The door is closed or partially closed during modes other than maximum cooling.

- The cold air bypass door actuator positions the cold air bypass door on command from the DATC module.
- Operation of the cold air bypass door actuator is the same as the air inlet door.

Defrost Door Actuator

The defrost door actuator is located on the plenum chamber. The actuator will position the defrost door fully open during defrost operation, partially open during floor/defrost and floor mode operation and fully closed during all other operations.

- The defrost door actuator positions the defrost door on command from the DATC module.
- Operation of the defrost door actuator is the same as the air inlet door.

Panel, Floor Console Door Actuator

The panel, floor console door actuator is located on the plenum chamber. The actuator operates the panel door which is mechanically linked to the floor console door. The actuator positions the panel door and floor console door fully open during panel mode and partially open during floor/panel operation. The doors are closed during other operations.

- The panel, floor console door actuator positions the panel and floor console doors on command from the DATC module.
- Operation of the panel door actuator is the same as the air inlet door.

Floor Outlet Door Actuator

The floor outlet door actuator positions the floor outlet door fully open during floor and floor/panel and floor/defrost operations. The door is closed during other operations.

- The floor outlet door actuator positions the floor outlet door on command from the DATC module.
- Operation of the floor door actuator is the same as the air inlet door.
- The floor outlet door actuator is in the full open position in OFF mode.

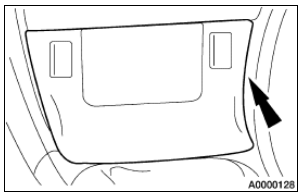
Climate Control Assembly

Removal and Installation

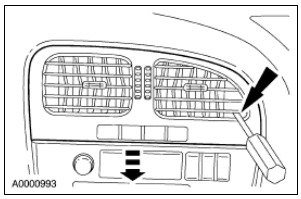
NOTE: If installing a new climate control assembly, dual automatic temperature control (DATC module), the new module must be configured. For additional information, refer to Section 418-01 .

1. Disconnect the battery. For additional information, refer to Section 414-01 .

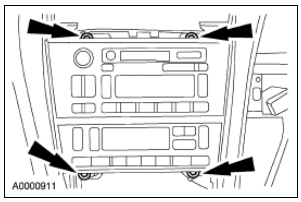
2. Remove the ashtray finish panel.
   - Disconnect the connector.



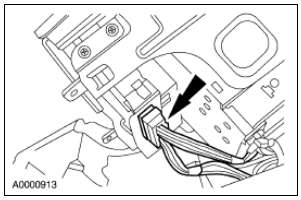
3. Insert a mini-pick in the center register and pull the center register from the instrument panel.
   - If equipped, disconnect the connector.



4. Remove the screws and pull the DATC and radio assembly away from the instrument panel.

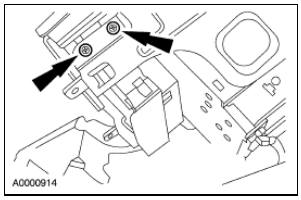


5. Disconnect the two connectors.



6. **NOTE:** The control assembly has three pins at the top of the bezel assembly which pilot in the bottom of the radio bezel. Use care when removing the control assembly.

   Remove the four screws (two on each side of the control assembly) and remove the dual automatic temperature control assembly.

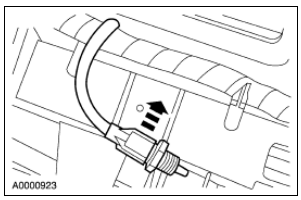


7. To install, reverse the removal procedure.

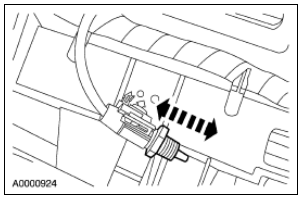
Ambient Air Temperature Sensor

Removal and Installation

1. Remove the wire harness connector and sensor.



2. Disconnect the wire harness connector.

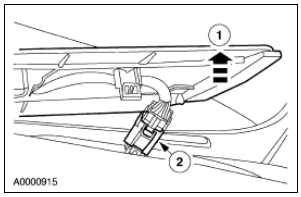


3. To install, reverse the removal procedure.

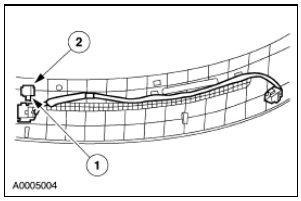
Sunload Sensor

Removal and Installation

1. Remove the instrument panel upper finish panel.
    1. Raise the upper finish panel.
    2. Disconnect the connector and remove the instrument panel finish panel.



2. Remove the dual sunload sensor.
    1. Disconnect the connector.
    2. Remove the dual sunload sensor.



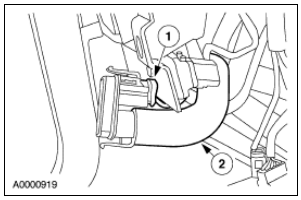
3. To install, reverse the removal procedure.

In-Vehicle Temperature Sensor

Removal and Installation

1. Remove the instrument cluster finish panel bezel. For additional information, refer to Section 501-12 .

2. Remove the in-car air temperature sensor.
    1. Disconnect the connector.
    2. Disconnect the aspirator hose and remove the in-car air temperature sensor.



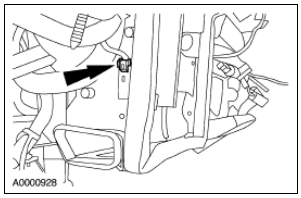
3. To install, reverse the removal procedure.

Air Discharge Temperature Sensor

Removal and Installation

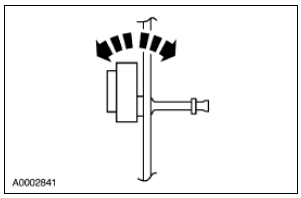
NOTE: RH shown, LH similar

1. Disconnect the connector.



2. ⚠ **CAUTION: Do not twist the sensor during the removal process. Twisting may damage the sensor or the housing.**

   Remove the sensor using a rocking motion.



3. To install, reverse the removal procedure.

Blend Door Actuator Air Inlet Door

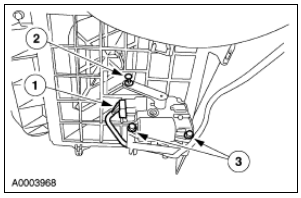
Removal and Installation

1. Disconnect the battery. Refer to Section 414-01 .

2. Remove the RH instrument panel insulator.

3. Remove the RH floor duct. For additional information, refer to Section 412-01 .

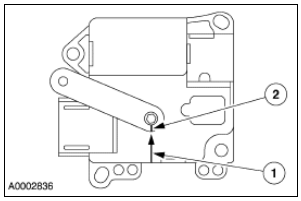
4. Remove the actuator.
    1. Disconnect the connector.
    2. Remove the coupling connector.
    3. Remove the screws and remove the actuator.



5. **NOTE:** New door actuator assemblies are shipped with the actuator in the mid-position. If reinstalling an actuator removed from the vehicle, use fused jumper wires to electrically drive the actuator to the mid-position to assist in assembly.

   To install, reverse the removal procedure.

   - If reinstalling an actuator removed from the vehicle, align the arrow (1) on the actuator housing with the line on the actuator coupling (2).



Blend Door Actuator Floor Duct Door

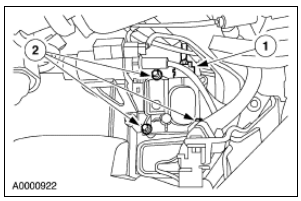
Removal and Installation

1. Disconnect the battery. For additional information, refer to Section 414-01 .

2. Remove the driver side instrument panel insulator.

3. Remove the LH floor duct. For additional information, refer to Section 412-01 .

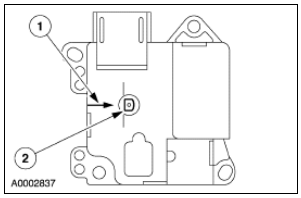
4. Remove the actuator.
    1. Disconnect the connector.
    2. Remove the three screws and remove the actuator.



5. **NOTE:** New door actuator assemblies are shipped with the actuator in the mid-position. If reinstalling an actuator removed from the vehicle, use jumper wires to electrically drive the actuator to the mid-position to assist in assembly.

   To install, reverse the removal procedure.

   - If reinstalling an actuator removed from the vehicle, align the arrow (1) on the actuator housing with the line on the actuator coupling (2).



Blend Door Actuator Cold Air Bypass Door

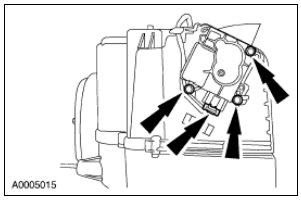
Removal and Installation

1. Disconnect the battery. For additional information, refer to Section 414-01 .

2. Remove the LH instrument panel insulator.
   - Disconnect the electrical connector.

3. Remove the LH floor duct. For additional information, refer to Section 412-01 .

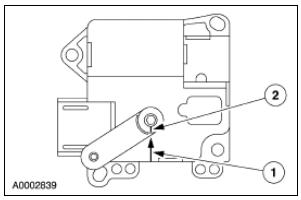
4. Remove the actuator.
   - Disconnect the connector.
   - Remove the screws and remove the actuator.



5. **NOTE:** New door actuator assemblies are shipped with the actuator in the mid-position. If reinstalling an actuator removed from the vehicle, use jumper wires to electrically drive the actuator to the mid-position to assist in assembly.

   To install, reverse the removal procedure.

   - If reinstalling an actuator removed from the vehicle, align the arrow (1) on the actuator housing with the line on the actuator coupling (2).

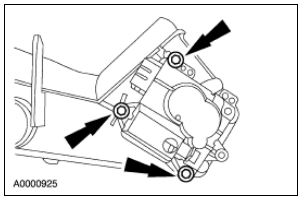


Blend Door Actuator Defrost Door

Removal and Installation

1. Remove the instrument panel. For additional information, refer to Section 501-12 .

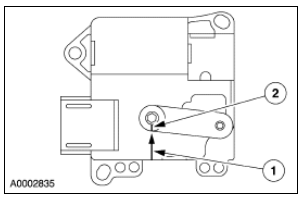
2. Remove the actuator.
   - Disconnect the connector.
   - Remove the three screws and remove the actuator.



3. **NOTE:** New door actuator assemblies are shipped with the actuator in the mid-position. If reinstalling an actuator removed from the vehicle, use jumper wires to electrically drive the actuator to the mid-position to assist in assembly.

   To install, reverse the removal procedure.

   - If reinstalling an actuator removed from the vehicle, align the arrow (1) on the actuator housing with the line on the actuator coupling (2).



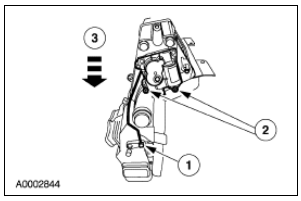
Blend Door Actuator Panel, Floor Console Door

Removal and Installation

1. Disconnect the battery. For additional information, refer to Section 414-01 .

2. Remove the instrument panel. For additional information, refer to Section 501-12 .

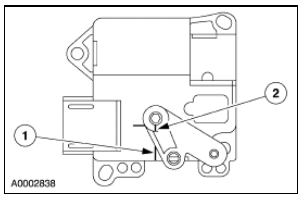
3. Remove the panel, floor console door actuator.
    1. Disconnect the link end from the center console door.
    2. Remove the screws.
    3. Remove the panel, floor console door actuator.



4. **NOTE:** New door actuator assemblies are shipped with the actuator in mid-position. If reinstalling an actuator removed from the vehicle, use jumper wires to electrically drive the actuator to the mid-position to assist in assembly.

   To install, reverse the removal procedure.

   - If reinstalling an actuator removed from the vehicle, align arrow (1) on the actuator housing with the line on the actuator coupling (2).
   - Position the actuator and the door fully open or fully closed.
   - Manually position the floor console door fully open or fully closed and then install the link.
   - Following installation, verify the door position by checking the airflow to the panel and floor console.

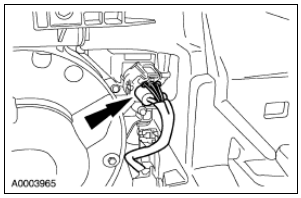


Blower Motor Speed Control

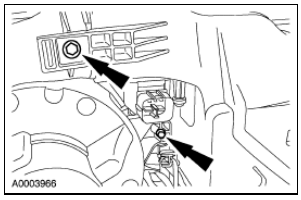
Removal and Installation

1. Remove the evaporator core housing. For additional information, refer to Section 412-02 .

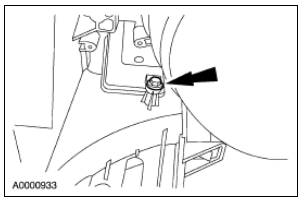
2. Disconnect the connector.



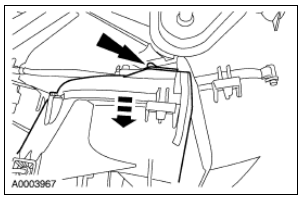
3. Remove the screws which attach the air inlet housing to the evaporator core housing.



4. Remove the blower motor speed control mounting screw.



5. Disengage the clip, separate the air inlet and evaporator housings and remove the blower motor speed control.



6. To install, reverse the removal procedure.

2002 Lincoln LS Contents/Index

-- D --

Daytime Running Lamps (DRL)

Daytime Running Lamps, Section Table of Contents

Degas Bottle

Diagnosis By Symptom

Diagnostic Flow Chart

Diagnostic Instructions - Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

Diagnostic Strategy

Diagnostic Trouble Code Charts

Diagnostics

Differential Pressure Feedback Exhaust Gas Recirculation (EGR) System - 3.0L

Differential Pressure Feedback Exhaust Gas Recirculation (EGR) System - 3.9L

Digital Transmission Range (TR) Sensor

Direct Clutch Drum Assembly

Disassembled Views

Disc and Pressure Plate

Door - Check Strap

Door

Drain Procedure

Draining

Drive Pinion Flange and Drive Pinion Seal

Driveline Angle Inspection

Driveline System - General Information, Section Table of Contents

Driveline System

DESC & OPER: Driveline System - General Information

DIAG & TEST: Driveline System - General Information

Driver Air Bag Module

Driveshaft Alignment Bushing

Driveshaft Center Bearing

Driveshaft Runout and Balancing

Driveshaft

DESC & OPER: Driveshaft

DIAG & TEST: Driveshaft

REM & INST: Driveshaft

Section Table of Contents

Instrument Cluster and Panel Illumination

The instrument cluster and panel lighting system provides dimmable backlighting to the following:

- instrument cluster (10849)
- headlamp switch (11654)
- panel dimmer switch
- climate control assembly
- audio unit
- ash tray
- power door lock switches
- power window switches
- memory set switch
- heated seat switch
- steering wheel switches
- shift lever indicator bezel
- vehicle emergency monitoring system (VEMS) switch
- power mirror switch
- message center

Instrument Cluster and Panel Illumination

Refer to Wiring Diagrams Cell 71 , for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter or equivalent 105-R0051
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Principles of Operation

Instrument Cluster and Panel Lighting Dimmable

The panel dimmer switch allows the brightness level of backlights and displays to be adjusted dependent upon the headlamp switch position and the dimmer switch position. The panel dimmer switch sends a signal to the instrument panel which then sends a backlighting intensity and dimming curve command over the standard corporate protocol (SCP) link to the front electronic module (FEM), the audio unit, and the dual automatic temperature control (DATC) module. The FEM then sends a pulse width modulated (PWM) dimming signal to the instrument cluster, the dimmable LEDs, and the dimmable incandescents.

When the headlamp switch is in the parking lamps ON, headlamps ON, or the autolamps ON position and the autolamp feature is active, synchronized dimming of the dimmable components can be controlled with the panel dimmer switch.

With the ignition switch in the RUN position and the headlamp switch in the OFF position, the audio unit, DATC module, tripometer, odometer, and selector lever indicator bezel will be at 100% brightness.

All backlighting will be disabled when the battery saver function has been activated.

Fault Management

The dimmable backlighting will default to 100% intensity if a panel dimmer switch failure occurs.

Inspection and Verification

NOTE: The instrument cluster and FEM must be reconfigured upon replacement. Refer to Section 418-01 .

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Binding or damaged panel dimmer switch	• Battery junction box (BJB) fuse(s) ♦ 425 (40A) ♦ 422 (20A) ♦ 432 (30A) • Central junction box (CJB) fuse(s) ♦ 202 (5A) ♦ 207 (5A) ♦ 213 (5A) ♦ 217 (5A) ♦ 220 (10A) ♦ 233 (10A) • Damaged bulb(s) • Damaged/corroded wiring harness • Damaged interior auxiliary junction box (IAJB) • Joint connectors • Damaged instrument cluster • Damaged front electronic module (FEM) • Damaged switches

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
    - check that the program card is correctly installed.
    - check the connections to the vehicle.
    - check the ignition switch position.

4. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTIC TEST. If the diagnostic tool responds with:
    - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
    - NO RESP/NOT EQUIP for front electronic module (FEM), Go To Pinpoint Test A .
    - NO RESP/NOT EQUIP for instrument cluster (ICM), Go To Pinpoint Test B .
    - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the ICM or FEM.

6. If the DTCs retrieved are related to the concern, go to the Instrument Cluster or FEM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

FEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1319	Driver Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1327	Passenger Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1342	ECU Is Defective	FEM	CLEAR the DTC. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new FEM. REFER to Section 419-10 .
B1438	Wiper Mode Select Switch Circuit Failure	FEM	REFER to Section 501-16 .
B1446	Wiper Park Sense Circuit Failure	FEM	REFER to Section 501-16 .
B1479	Wiper Washer Fluid Level Sensor Circuit Failure	FEM	REFER to Section 501-16 .
B1499	Lamp Turn Signal Left Circuit Failure	FEM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1503	Lamp Turn Signal Right Circuit Failure	FEM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1519	Hood Switch Circuit Failure	FEM	REFER to Section 419-01A .
B1567	Lamp Headlamp High Beam Circuit Failure	FEM	REFER to Section 417-01 .
B1676	Battery Pack Voltage Out of Range	FEM	REFER to Section 414-00 .
B2214	Window Passenger Front Up Switch Short to Battery	FEM	REFER to Section 501-11 .
B2215	Window Passenger Front Down Switch Short to Battery	FEM	REFER to Section 501-11 .
B2312	Mirror Passenger Horizontal Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2316	Mirror Passenger Vertical Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2442	Intrusion Sensor Fault	FEM	REFER to Section 419-01A .
B2477	Module Configuration Failure	FEM	REFER to Section 418-01 .
C1284	Oil Pressure Switch Failure	FEM	REFER to Section 413-01 .
C1446	Brake Switch Circuit Failure	FEM	REFER to Section 413-01 .
C1924	VAPS Solenoid Actuator Output Circuit Short to Ground	FEM	REFER to Section 211-00 .
C1925	VAPS Solenoid Actuator Return Circuit Failure	FEM	REFER to Section 211-00 .

Instrument Cluster Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action

B1201	Fuel Sender Circuit Failure	ICM	REFER to Section 413-01 .
B1205	EIC Switch-1 Assembly Circuit Failure	ICM	REFER to Section 413-01 .
B1209	EIC Switch-2 Assembly Circuit Failure	ICM	REFER to Section 413-01 .
B1213	Anti-Theft Number of Programmed Keys Is Below Minimum	ICM	REFER to Section 419-01B .
B1246	Dim Panel Potentiometer Switch Circuit Failure	ICM	GO to Pinpoint Test G .
B1342	ECU Is Defective	ICM	CLEAR and DOCUMENT the DTCs. CARRY OUT the instrument cluster self-test. INSTALL a new instrument cluster if DTC B1342 is retrieved again. REFER to Section 413-01 .
B1352	Ignition Key-In Circuit Failure	ICM	REFER to Section 413-09 .
B1470	Lamp Headlamp Input Circuit Failure	ICM	REFER to Section 417-01 .
B1492	Ignition Cylinder Sensor Open Circuit	ICM	REFER to Section 419-01B .
B1567	Lamp Headlamp High eam Circuit Failure	ICM	REFER to Section 417-01 .
B1600	PATS Ignition Key Transponder Signal Is Not Received	ICM	REFER to Section 419-01B .
B1601	PATS Received Incorrect Key-Code From Ignition Key Transponder	ICM	REFER to Section 419-01B .
B1602	PATS Received Invalid Format of Key-Code From Ignition Key Transponder	ICM	REFER to Section 419-01B .
B1676	Battery Pack Voltage Out of Range	ICM	REFER to Section 413-01
B1681	PATS Transceiver Module Signal Is Not Received	ICM	REFER to Section 419-01B .
B1689	Autolamp Delay Circuit Failure	ICM	REFER to Section 417-01 .
B1875	Turn Signal / Hazard Switch Signal Circuit Failure	ICM	REFER to Section 417-01 .
B2103	Antenna Not Connected	ICM	REFER to Section 419-01B .
B2139	Data Mismatch (Receive Data Does Not Match What Was Expected)	ICM	REFER to Section 419-01B .
B2141	NVM Configuration Failure	ICM	REFER to Section 419-01B .
B2143	NVM Memory Failure	ICM	REFER to Section 413-01 .
B2162	Data Mismatch #2 (Receive Data Does Not Match What Was Expected)	ICM	REFER to Section 419-01B .
B2328	Column Reach Feedback Potentiometer Circuit Failure	ICM	REFER to Section 211-04 .
B2332	Column Tilt Feedback Potentiometer Circuit Failure	ICM	REFER to Section 211-04 .
B2351	Steering Column Switch Circuit Failure	ICM	REFER to Section 211-04 .
B2431	Transponder Programming Failed	ICM	REFER to Section 419-01B .

B2472	Fog Lamp Switch Failure	ICM	REFER to Section 417-01 .
B2477	Module Configuration Failure	ICM	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS, ABS/TC, IVD	CARRY OUT the ABS, ABS/TC, or IVD self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/ PRNDL	PCM	CARRY OUT the PCM self-test.
U1073	SCP (J1850) Invalid or Missing Data for Engine Coolant Fluid Temperature	PCM	CARRY OUT the PCM self-test.
U1123	SCP (J1850) Invalid or Missing Data for Odometer Rolling Count	ABS, ABS/TC, IVD	CARRY OUT the ABS, ABS/TC, IVD self-test.
U1147	SCP (J1850) Invalid or Missing Data for Vehicle Security System	PCM	CARRY OUT the PCM self-test.

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE FRONT ELECTRONIC MODULE

PINPOINT TEST B: NO COMMUNICATION WITH THE INSTRUMENT CLUSTER MODULE

PINPOINT TEST C: THE INSTRUMENT CLUSTER ILLUMINATION IS INOPERATIVE

PINPOINT TEST D: THE CONTROL ILLUMINATION IS INOPERATIVE ALL LEDS AND INCANDESCENTS

PINPOINT TEST E: THE CONTROL ILLUMINATION IS INOPERATIVE ALL LEDS OR INCANDESCENTS

PINPOINT TEST F: THE CONTROL ILLUMINATION IS ALWAYS ON ALL LEDS OR INCANDESCENTS

PINPOINT TEST G: THE CONTROL ILLUMINATION IS ALWAYS ON ALL LEDS AND INCANDESCENTS

PINPOINT TEST H: A SINGLE ILLUMINATION SOURCE IS INOPERATIVE

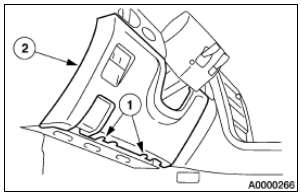
PINPOINT TEST I: THE INSTRUMENT PANEL ILLUMINATION DOES NOT DIM

Switch Panel Dimmer

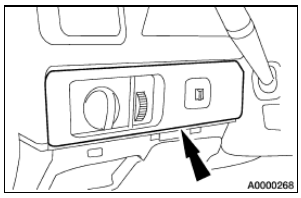
Removal and Installation

1. Disconnect the battery ground cable. Refer to Section 414-01 .

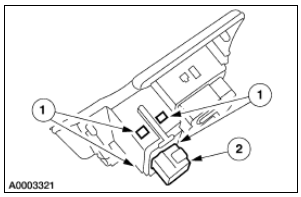
2. Remove the lower instrument panel finish panel.
    1. Remove the bolts.
    2. Remove the lower instrument panel finish panel.



3. Remove the instrument panel finish panel.
    - Disconnect the electrical connectors.



4. Remove the panel dimmer switch.
    1. Release the four retaining clips.
    2. Remove the panel dimmer switch.



5. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

   To install, reverse the removal procedure.

Torque Specifications

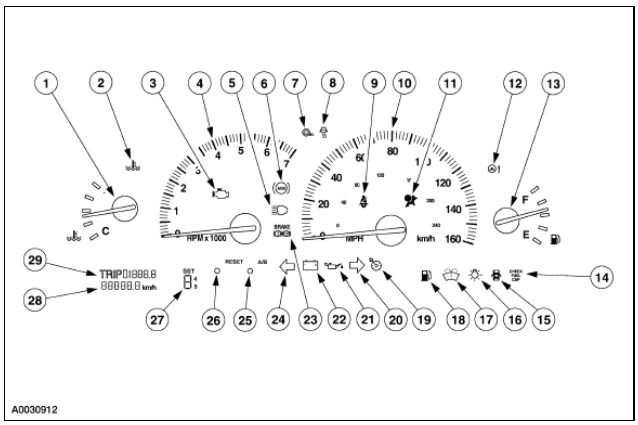
Description	Nm	lb-ft	lb-in
Battery ground cable bolt	10		89
Steering column reinforcement bolts	9		80
Instrument panel tunnel reinforcement bolts	20	15	

Instrument Cluster

NOTE: Miles per hour (mph) instrument cluster shown, kilometers per hour (km/h) instrument cluster similar.

The standard instrument cluster consists of the following:

Instrument Cluster (Standard)



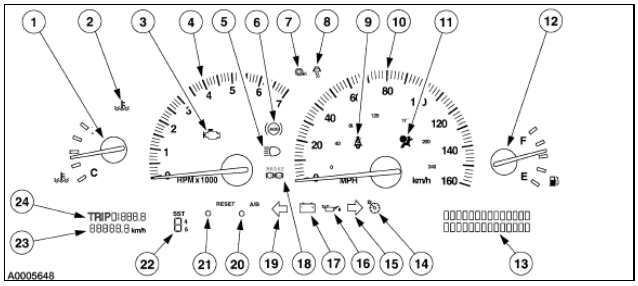
Item	Part Number	Description
1		Engine coolant temperature gauge
2		Engine over-temperature indicator
3		Malfunction indicator lamp (MIL) indicator
4		Tachometer
5		High beam indicator
6		Anti-lock brake system (ABS)
7		Traction control indicator
8		Advance traction control indicator (if equipped)
9		Safety belt indicator
10		Speedometer
11		Air bag indicator
12		Steering column lock indicator (if equipped)
13		Fuel gauge
14		CHECK FUEL CAP indicator
15		Door ajar indicator
16		Lamp outage indicator
17		Low washer fluid indicator
18		Low fuel indicator
19		Speed control indicator
20		Right turn signal indicator
21		Low oil pressure indicator
22		Charging system indicator
23		Brake system warning indicator (BRAKE)

24		Left turn signal indicator
25		A/B trip odometer button
26		Trip odometer button (reset)
27		Shift indicator
28		Odometer
29		Trip odometer

NOTE: Miles per hour (mph) instrument cluster shown, kilometers per hour (km/h) instrument cluster similar.

The optional instrument cluster consists of the following:

Instrument Cluster (Optional)



Item	Part Number	Description
1		Engine coolant temperature gauge
2		Engine over-temperature indicator
3		Malfunction indicator lamp (MIL)
4		Tachometer
5		High beam indicator
6		Anti-lock brake system (ABS)
7		Traction control indicator
8		Advance traction control indicator
9		Safety belt indicator
10		Speedometer
11		Air bag indicator
12		Fuel gauge
13		Message center display
14		Speed control indicator
15		Right turn signal indicator
16		Low oil pressure indicator
17		Charging system indicator
18		Brake system warning indicator (BRAKE)
19		Left turn signal indicator
20		A/B trip odometer button
21		Trip odometer button (reset)
22		Shift indicator
23		Odometer
24		Trip odometer

Instrument Cluster

Refer to Wiring Diagrams Cell 60 , Instrument Cluster for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool
 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Principles of Operation

NOTE: The instrument cluster, front electronic module (FEM), and the rear electronic module (REM) must be reconfigured upon replacement. Refer to Section 418-01 .

NOTE: The diagnostic tool may display ICM for the instrument cluster.

NOTE: For any concerns with the restraint control module (RCM), refer to Section 501-20B .

The instrument cluster is a hybrid electronic instrument cluster (HEC). The vehicle electronic functions are divided into zones. The instrument cluster, FEM, and REM use the standard corporate protocol (SCP) communication network to transmit and receive information. As a technician, it is very important to understand:

- where the input (command) originates from
- all information (messages) necessary in order for a feature to operate
- which module(s) receive(s) the input or command message
- does the module which received the input (message), control the output of the feature, or does it output a message over the SCP communication network to another module
- which module controls the output of the feature

The instrument cluster communicates with the FEM, REM, anti-lock brake system/traction control/interactive vehicle dynamics (ABS/TC/IVD), powertrain control module (PCM), steering column lock (SCL), message center (MC) module, and the restraint control module (RCM) over the SCP to control the gauges, indicators, and chimes.

Warning Indicator Functionality

Low Oil Pressure Indication

The low oil pressure switch is hardwired to the FEM. The status of the oil pressure is sent from the FEM to the instrument cluster via the standard corporate protocol (SCP) communication network.

Safety Belt Warning Indication

The safety belt switch is hardwired directly to the instrument cluster. The instrument cluster uses the input from the switch to determine whether or not the safety belt is fastened.

Door Ajar Warning Indication (If equipped)

The door switches for the rear of the vehicle are directly hardwired to the REM. The REM uses the multiple inputs from the door switches to determine whether the doors are in the opened or closed position. This information is then relayed from the REM to the instrument cluster via the SCP communication network. The door switches for the front of the vehicle are directly hardwired to the FEM. The FEM uses the multiple inputs from the door switches to determine whether the doors are in the opened or closed position. This information is then relayed to the instrument cluster via the SCP communication network.

Charging System Warning Indication

The charging system is hardwired to the PCM. The status of the charging system is then relayed from the PCM to the instrument cluster via the SCP communication network.

Brake Warning Indication

The brake warning indicator supports three separate functions. Those functions are brake system failure, low brake fluid level, and engagement of the parking brake control. These functions are controlled by the parking brake control switch, the brake fluid level switch and the brake system itself. The brake fluid level switch and the parking brake control switch are hardwired directly to the FEM. The status of both the fluid and parking brake control switches is sent from the FEM to the instrument cluster via the SCP communication network. The brake system status is sent from the ABS/TC/IVD to the instrument cluster via the SCP communication network.

High Beam Indication

The multifunction switch is hardwired directly to the instrument cluster. The headlamp status is then sent from the instrument cluster to the FEM via the SCP communication network.

Low Washer Fluid Warning Indication (If equipped)

The low washer fluid level switch is hardwired directly to the FEM. The FEM monitors the washer fluid level status and sends it to the instrument cluster via the SCP communication network.

Air Bag Warning Indication

The AIR BAG warning indicator will be illuminated when the electronic crash sensor (ECS) sends a ground signal to the instrument cluster. The prove out of the AIR BAG warning indicator is controlled by the ECS.

ABS Warning Indication

The status of the ABS/TC/IVD system is sent to the instrument cluster via the SCP communication network. The instrument cluster uses this input to determine whether or not there is a fault with the ABS/TC/IVD system.

Traction Control Warning Indication

The status of the traction control is communicated to the instrument cluster from the TC/IVD module via the SCP communication network.

Advance Traction Warning Indication

The status of the system is communicated to the instrument cluster from the IVD module via the SCP communication network.

Lamp Outage Warning Indication (If equipped)

The FEM and REM both control the exterior illumination. If the exterior lamps are the cause of the fault, these two modules will notify the instrument cluster via the SCP communication network and cause the lamp outage warning indicator to illuminate.

Malfunction Indicator Lamp (MIL)

After the engine is started, the MIL will prove out for a duration of three seconds. If the instrument cluster does not receive a message from the PCM within five seconds, it will send two messages to the PCM and attempt to reestablish communication. If the instrument cluster is unable to reestablish communication, the instrument cluster will illuminate the MIL and log a diagnostic trouble code (DTC).

Turn/Hazard Indication

The multifunction switch is hardwired directly to the instrument cluster. The instrument cluster sends the signal from the multifunction switch to both the FEM and REM via the SCP communication network while simultaneously illuminating the turn/hazard indicators. The FEM and the REM use these inputs from the instrument cluster to illuminate the exterior lighting as necessary.

Speed Control Indication

The speed control status is monitored by the PCM and then relayed to the instrument cluster via the SCP communication network. The speed control indicator illuminates when the speed control is set.

Low Fuel Warning Indication (If equipped)

There are two fuel tank senders, and they are hardwired directly to the REM. The status of the fuel level from both senders is sent from the REM over the SCP communication network to the instrument cluster. The instrument cluster uses these inputs to determine the overall fuel level in the tank and illuminates the low fuel warning indicator if the fuel level is low.

Engine Over-Temperature Indicator

The cylinder head temperature sending unit is hardwired directly to the PCM. The status of the cylinder head temperature is sent from the PCM over the SCP communication network to the instrument cluster. The instrument cluster then determines whether or not the cylinder head temperature is above the over-temperature threshold.

Steering Column Lock Indication

The steering column lock status is monitored by the instrument cluster from the input of the steering column lock (SCL) module via the standard corporate protocol (SCP) communication network.

Gauge Functionality

Temperature Gauge

The cylinder head temperature sending unit is hardwired directly to the PCM. The status of the cylinder head temperature is sent from the PCM over the SCP communication network to the instrument cluster. Normal operating temperature is 140° F (60° C) to 248° F (120° C). Redline starts at 249.8° F (121° C).

Tachometer Gauge

The crankshaft position sensor is hardwired directly to the PCM. The status of the crankshaft position sensor is sent from the PCM to the instrument cluster via the SCP communication network.

Speedometer Gauge

The vehicle speed signal (VSS) from all four wheels are hardwired directly to the ABS/TC/IVD. The speed status is then sent to the instrument cluster by the ABS/TC/IVD via the SCP communication network.

Fuel Gauge

The fuel gauge system has a saddle-type fuel tank with two integrated fuel senders: the fuel delivery module (FDM) and the jet pump module (JPM). The FDM is located in the right side of the fuel tank and the JPM is located in the left side of the fuel tank. Fuel level status is sent directly to the rear electronic module (REM), which is hardwired to the fuel senders. The REM sends the fuel data to the instrument cluster via the standard corporate protocol (SCP) line. Normal operating range of the FDM is from 16 ± 2 ohms at empty (E) to 155 ± 4 ohms at full (F). Normal operating range of the JPM sender is from 19 ± 2 ohms at empty (E) to 160 ± 2 ohms at full (F). If either the REM or JPM fuel sender has an open or shorted signal, the instrument cluster will log diagnostic trouble code (DTC) B1201. If the JPM sender is open, the fuel gauge will default to the FDM sender value only and the fuel gauge will indicate E to 1/2 tank (depending on the fuel level on the FDM side of the tank). If the FDM is open, the fuel gauge will default to the empty position.

CHECK FUEL CAP

The CHECK FUEL CAP indicator is used to indicate significant leaks in the fuel tank evaporative system due to a loose fuel cap. Fuel tank pressure is monitored by the PCM and if a leak is detected it signals a fault to the instrument cluster via the SCP network. Once the PCM has detected a loose fuel cap and the CHECK FUEL CAP indicator is illuminated, the indicator will remain illuminated until the fuel cap is secured and the vehicle has been running for several minutes. For additional information, refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Digital Segment Displays

Trip A/B And Odometer Displays

The vehicle speed signal (VSS) from all four wheels are hardwired directly to the ABS/TC/IVD. The speed status is then sent to the instrument cluster by the ABS/TC/IVD via the SCP communication network to establish a rolling count.

PRNDL Display

The digital transmission range (DTR) sensor is hardwired directly to the PCM. The status of the gear selection is sent to the instrument cluster from the PCM via the SCP communication network.

Parameter Reset and Key Programming

NOTE: The instrument cluster parameters must be reset upon installation of a new instrument cluster.

NOTE: Both passive anti-theft system (PATS) keys are needed to carry out this procedure.

To reset the instrument cluster parameters and program the keys, complete the following procedure:

1. Connect the diagnostic tool.

2. Select the instrument cluster.
3. Select ENTER SECURITY ACCESS. Wait 10 minutes for security access to be granted.
4. Select PARAMETER RESET.
5. Disconnect the diagnostic tool.
6. Place the first PATS key in the OFF position.
7. Place the key in the ON position.
8. Remove the key.
9. Place the second PATS key in the ON position.
10. Place the key in the OFF position (the programming sequence is complete).

NOTE: If the vehicle fails to start following completion of the parameter reset and key programming sequence, clear the keep alive memory (KAM) by disconnecting the battery for five minutes. For additional information about the battery disconnect procedure, refer to Section 414-00 .

Inspection and Verification

NOTE: The instrument cluster, REM and FEM must be reconfigured upon replacement. Refer to Section 418-01 .

NOTE: For any concerns with the restraint control module (RCM), refer to Section 501-20B .

1. Verify the customer concern by operating the instrument cluster to duplicate the condition by observing the indicators, warning displays, and gauges to determine if they are operating correctly with the ignition switch:

- in RUN with the engine off
- in START before the ignition switch is released
- in RUN with the engine running

2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Low washer fluid level • Damaged fuel tank • Low engine coolant level • Damaged accessory drive belt	• Central junction box (CJB) fuse(s): ♦ 204 (5A) ♦ 205 (5A) ♦ 207 (5A) ♦ 213 (5A) ♦ 217 (5A)

• Low engine oil level • Low brake fluid level	♦ 219 (15A) ♦ 220 (10A) ♦ 224 (5A) ♦ 229 (5A) ♦ 230 (5A) ♦ 235 (5A) • Battery junction box (BJB) fuse(s): ♦ 422 (20A) ♦ 425 (40A) ♦ 427 (30A) ♦ 430 (30A) • Damaged circuitry • Damaged connectors • Damaged switches or sensors

3. If the inspection reveals obvious concern(s) that can be readily identified, repair as necessary.

4. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

5. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

6. Carry out the DATA LINK DIAGNOSTIC TEST. If the diagnostic tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for instrument cluster, GO to Pinpoint Test A.
   - NO RESP/NOT EQUIP for FEM, GO to Pinpoint Test B.
   - NO RESP/NOT EQUIP for REM, GO to Pinpoint Test C.
   - NO RESP/NOT EQUIP for RCM, REFER to Section 501-20B .
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the instrument cluster.

7. If the DTCs retrieved are related to the concern, go to the Instrument Cluster Diagnostic Trouble Code (DTC) Index to continue diagnostics.

8. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.

Instrument Cluster Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1201	Fuel Sender Circuit Failure	Instrument Cluster	GO to Pinpoint Test D .
B1205			

	EIC Switch-1 Assembly Circuit Failure	Instrument Cluster	INSTALL a new instrument cluster; REFER to Instrument Cluster . TEST the system for normal operation.
B1209	EIC Switch-2 Assembly Circuit Failure	Instrument Cluster	INSTALL a new instrument cluster; REFER to Instrument Cluster . TEST the system for normal operation.
B1213	Anti-Theft Number of Programmed Keys Is Below Minimum	Instrument Cluster	REFER to Section 419-01B .
B1246	Dim Panel Potentiometer Switch Circuit Failure	Instrument Cluster	REFER to Section 413-00 .
B1342	ECU Is Defective	Instrument Cluster	CLEAR and DOCUMENT the DTCs. CARRY OUT the instrument cluster self-test. INSTALL a new instrument cluster if DTC B1342 is retrieved again. REFER to Instrument Cluster .
B1352	Ignition Key-In Circuit Failure	Instrument Cluster	REFER to Section 413-09 .
B1470	Lamp Headlamp Input Circuit Failure	Instrument Cluster	REFER to Section 417-01 .
B1567	Lamp Headlamp High Beam Circuit Failure	Instrument Cluster	REFER to Section 417-01 .
B1600	PATS Ignition Key Transponder Signal Is Not Received	Instrument Cluster	REFER to Section 419-01B .
B1601	PATS Received Incorrect Key-Code From Ignition Key Transponder	Instrument Cluster	REFER to Section 419-01B .
B1602	PATS Received Invalid Format of Key-Code From Ignition Key Transponder	Instrument Cluster	REFER to Section 419-01B .
B1676	Battery Pack Voltage Out of Range	Instrument Cluster	GO to Pinpoint Test J .
B1681	PATS Transceiver Module Signal Is Not Received	Instrument Cluster	REFER to Section 419-01B .
B1689	Autolamp Delay Circuit Failure	Instrument Cluster	REFER to Section 417-01 .
B1875	Turn Signal / Hazard Switch Signal Circuit Failure	Instrument Cluster	REFER to Section 417-01 .
B2103	Antenna Not Connected	Instrument Cluster	REFER to Section 419-01B .
B2139	Security Data Mismatch (Receive Data Does Not Match What Was Expected)	Instrument Cluster	REFER to Section 419-01B .
B2141	NVM Configuration Failure	Instrument Cluster	REFER to Section 419-01B .
B2143	NVM Memory Failure	Instrument Cluster	GO to Pinpoint Test Z .
B2162	Security Data Mismatch #2 (Receive Data Does Not Match What Was Expected)	Instrument Cluster	REFER to Section 419-01B .
B2328	Column Reach Feedback Potentiometer Circuit Failure	Instrument Cluster	REFER to Section 211-04 .

B2332	Column Tilt Feedback Potentiometer Circuit Failure	Instrument Cluster	REFER to Section 211-04 .
B2351	Steering Column Switch Circuit Failure	Instrument Cluster	REFER to Section 211-04 .
B2431	Transponder Programming Failed	Instrument Cluster	REFER to Section 419-01B .
B2472	Fog Lamp Switch Failure	Instrument Cluster	REFER to Section 417-01 .
B2477	Module Configuration Failure	Instrument Cluster	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS/TC/IVD	CARRY OUT the ABS/TC/IVD self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/ PRNDL	PCM	CARRY OUT the PCM self-test.
U1073	SCP (J1850) Invalid or Missing Data for Engine Coolant Fluid Temperature	PCM	CARRY OUT the PCM self-test.
U1123	SCP (J1850) Invalid or Missing Data for Odometer Rolling Count	ABS/TC/IVD	CARRY OUT the ABS/TC/IVD self-test.
U1131	SCP (J1850) Invalid or Missing Data for Fuel System	Instrument Cluster	GO to Pinpoint Test D .
U1147	SCP (J1850) Invalid or Missing Data for Vehicle Security System	PCM	REFER to Section 419-01B .
U1262	SCP (J1850) Communication Bus Fault	Instrument Cluster	REFER to Section 418-00 .

FEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1319	Driver Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1327	Passenger Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1342	ECU Is Defective	FEM	CLEAR the DTC. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new FEM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test.
B1438	Wiper Mode Select Switch Circuit Failure	FEM	REFER to Section 501-16 .
B1446	Wiper Park Sense Circuit Failure	FEM	REFER to Section 501-16 .
B1479	Wiper Washer Fluid Level Sensor Circuit Failure	FEM	REFER to Section 413-01 .
B1499	Lamp Turn Signal Left Circuit Failure	FEM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit	FEM	REFER to Section 417-01 .

	Short to Battery		
B1503	Lamp Turn Signal Right Circuit Failure	FEM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1519	Hood Switch Circuit Failure	FEM	REFER to Section 419-01A .
B1567	Lamp Headlamp High Beam Circuit Failure	FEM	REFER to Section 417-01 .
B1676	Battery Pack Voltage Out of Range	FEM	REFER to Section 414-00 .
B1794	Lamp Headlamp Low Beam Circuit Failure	FEM	REFER to Section 417-01 .
B2214	Window Passenger Front Up Switch Short to Battery	FEM	REFER to Section 501-11 .
B2215	Window Passenger Front Down Switch Short to Battery	FEM	REFER to Section 501-11 .
B2312	Mirror Passenger Horizontal Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2316	Mirror Passenger Vertical Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2443	Powertrain Performance Mode Switch Circuit Failure	FEM	Not Applicable
B2477	Module Configuration Failure	FEM	REFER to Section 418-01 .
C1284	Oil Pressure Switch Failure	FEM	REFER to Section 413-01 .
C1446	Brake Switch Circuit Failure	FEM	REFER to Section 413-01 .
C1924	VAPS Solenoid Actuator Output Circuit Short to Ground	FEM	REFER to Section 211-00 .
C1925	VAPS Solenoid Actuator Return Circuit Failure	FEM	REFER to Section 211-00 .
U1027	SCP (J1850) Invalid or Missing Data for Engine RPM	PCM	CARRY OUT the PCM self-test.
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission / Transaxle / PRNDL	PCM	CARRY OUT the PCM self-test.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	Instrument Cluster	CARRY OUT the instrument cluster self-test.
U1222	SCP (J1850) Invalid or Missing Data for Interior Lamps	Instrument Cluster	CARRY OUT the instrument cluster self-test.
U1227	SCP (J1850) Invalid or Missing Data for Body Status Request	Instrument Cluster	CARRY OUT the instrument cluster self-test.

REM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1201	Fuel Sender Circuit Failure	REM	REFER to Section 413-01 .
B1300	Power Door Lock Circuit Failure	REM	REFER to Section 501-14B .
B1310	Power Door Unlock Circuit Failure	REM	REFER to Section 501-14B .
B1331	Deck Lid Ajar Rear Door Circuit Failure	REM	REFER to Section 417-02 .
B1335	Door Ajar RR Circuit Failure	REM	REFER to Section 417-02 .
B1342	ECU Is Defective	REM	CLEAR the DTC. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new REM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test.
B1483	Brake Pedal Input Circuit Failure	REM	REFER to Section 417-01 .
B1499	Lamp Turn Signal Left Circuit Failure	REM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	REM	REFER to Section 417-01 .
B1503	Lamp Turn Signal Right Circuit Failure	REM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	REM	REFER to Section 417-01 .
B1551	Deck Lid Release Circuit Failure	REM	REFER to Section 501-14B .
B1571	Door Ajar LR Circuit Failure	REM	REFER to Section 417-02 .
B1676	Battery Pack Voltage Out of Range	REM	REFER to Section 414-00 .
B2172	Inertia Switch Input Circuit Open	REM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
B2174	Window Driver Rear Remote Up Switch Short to Battery	REM	REFER to Section 501-11 .
B2178	Window Driver Rear Remote Down Switch Short to Battery	REM	REFER to Section 501-11 .
B2190	Window Passenger Rear Remote Up Switch Short to Battery	REM	REFER to Section 501-11 .
B2194	Window Passenger Rear Remote Down Switch Short to Battery	REM	REFER to Section 501-11 .
B2477	Module Configuration Failure	REM	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/ PRNDL	PCM	CARRY OUT the PCM self-test.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	Instrument Cluster	CARRY OUT the instrument cluster self-test

PCM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
P0457	Fuel Fill Cap Off	PCM	GO to Pinpoint Test AA .

For a complete list of PCM DTCs, refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE INSTRUMENT CLUSTER

PINPOINT TEST B: NO COMMUNICATION WITH THE FRONT ELECTRONIC MODULE

PINPOINT TEST C: NO COMMUNICATION WITH THE REAR ELECTRONIC MODULE

PINPOINT TEST D: INCORRECT FUEL GAUGE INDICATION

PINPOINT TEST E: INCORRECT TEMPERATURE GAUGE INDICATION

PINPOINT TEST F: AN INDICATOR IS INOPERATIVE/ALWAYS ON LOW OIL PRESSURE

PINPOINT TEST G: THE SPEEDOMETER IS INOPERATIVE

PINPOINT TEST H: THE SAFETY BELT WARNING INDICATOR IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

PINPOINT TEST I: THE DOOR AJAR INDICATOR IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

PINPOINT TEST J: THE CHARGE SYSTEM WARNING INDICATOR IS NEVER/ALWAYS ON

PINPOINT TEST K: THE BRAKE WARNING INDICATOR IS ALWAYS ON

PINPOINT TEST L: AN INDICATOR IS INOPERATIVE/ALWAYS ON HIGH BEAM

PINPOINT TEST M: AN INDICATOR IS INOPERATIVE/ALWAYS ON LOW WASHER FLUID WARNING

PINPOINT TEST N: AN INDICATOR IS INOPERATIVE/ALWAYS ON ABS WARNING

PINPOINT TEST O: AN INDICATOR IS INOPERATIVE / ALWAYS ON TRACTION CONTROL AND ADVANCE TRACTION

PINPOINT TEST P: AN INDICATOR IS INOPERATIVE / ALWAYS ON LAMP OUTAGE

PINPOINT TEST Q: AN INDICATOR IS INOPERATIVE/ALWAYS ON MALFUNCTION INDICATOR LAMP (MIL)

PINPOINT TEST R: AN INDICATOR IS INOPERATIVE/ALWAYS ON TURN / HAZARD

PINPOINT TEST S: AN INDICATOR IS INOPERATIVE / ALWAYS ON STEERING COLUMN LOCK WARNING

PINPOINT TEST T: THE TACHOMETER IS INOPERATIVE

PINPOINT TEST U: AN INDICATOR IS INOPERATIVE/ALWAYS ON SPEED CONTROL

PINPOINT TEST V: AN INDICATOR IS INOPERATIVE/ALWAYS ON PRNDL DISPLAY

PINPOINT TEST W: AN INDICATOR IS INOPERATIVE / ALWAYS ON LOW FUEL WARNING

PINPOINT TEST X: AN INDICATOR IS INOPERATIVE / ALWAYS ON ENGINE OVER-TEMPERATURE

PINPOINT TEST Y: THE AIR BAG WARNING INDICATOR IS INOPERATIVE/ALWAYS ON

PINPOINT TEST Z: THE ODOMETER IS INOPERATIVE

PINPOINT TEST AA: THE CHECK FUEL CAP INDICATOR IS INOPERATIVE/ALWAYS ON

Instrument Cluster

Removal and Installation

1. **⚠ CAUTION: Prior to removal of the module, it is necessary to upload module configuration information to the diagnostic tool. This information needs to be downloaded into the new module once installed. For additional information, refer to Section 418-01 .**

   ⚠ CAUTION: Electronic modules are sensitive to electrical charges. If exposed to these charges, damage may result.

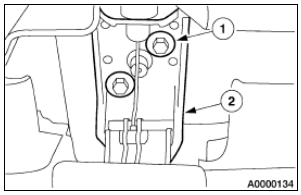
   ⚠ CAUTION: To avoid damaging the instrument cluster lens, place a protective cloth over the upper steering column cover before removing the instrument cluster.

   NOTE: The instrument cluster is not repairable at the dealership. Do not disassemble the instrument cluster.

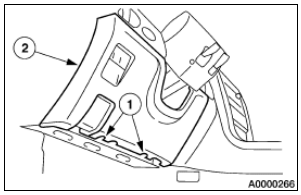
   Remove the instrument panel cluster finish panel. For additional information, refer to Section 501-12 .

2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

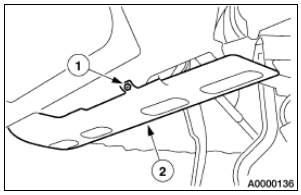
3. Remove the hood latch release handle.
   1. Remove the bolts.
   2. Remove the handle.



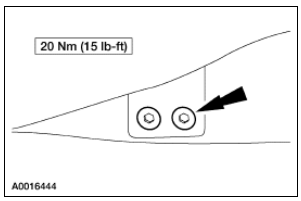
4. Remove the instrument panel steering column cover.
   1. Remove the bolts.
   2. Remove the cover.



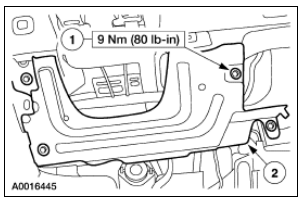
5. Remove the floor heat duct.
   1. Remove the bolt.
   2. Remove the duct.



6. Loosen the two LH instrument panel tunnel brace bolts.



7. Remove the steering column reinforcement.
    1. Remove the bolts.
    2. Remove the reinforcement.

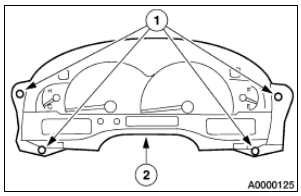


8. Lower the steering column.
    1. Loosen, but do not remove, the four nuts.
    2. Lower the column.



9. Disconnect the passive anti-theft system (PATS) transceiver electrical connector. For additional information, refer to Section 419-01B .

10. Remove the instrument cluster.
    1. Remove the bolts.
    2. Remove the instrument cluster.
    - Disconnect the electrical connectors.



11. **⚠ CAUTION: Once the new module is installed, it is necessary to download the module configuration information from the diagnostic tool into the new module. For additional information, refer to Section 418-01 .**

    ⚠ CAUTION: To avoid damaging the instrument cluster lens, place a protective cloth over the upper steering column cover before installing the instrument cluster.

    NOTE: Following the installation of a new instrument cluster, carry out the Parameter Reset and Key Programming procedure in this section.

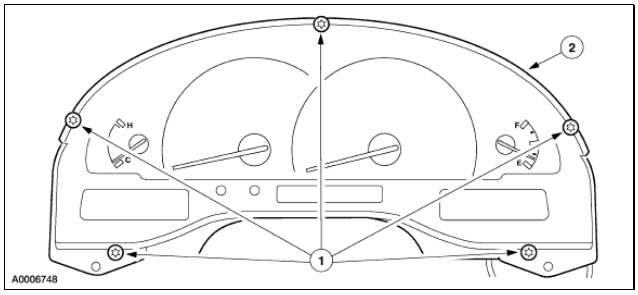
    To install, reverse the removal procedure.

Cluster Lens

Removal and Installation

1. Remove the instrument cluster. For additional information, refer to Instrument Cluster in this section.

2. Remove the cluster lens.
    1. Remove the screws.
    2. Remove the cluster lens.



3. To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-ft	lb-in
Horn bolt	20	15	
Horn switch pad bolt	6		53

Horn

The horn system includes the following:

- Horn relay.
- Horn (13832).
- Air bag sliding contact (14A664).
- Steering wheel switch harness.
- Horn switch.

Horn

Refer to Wiring Diagrams Cell 44 , for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Principles of Operation

When the horn switch is depressed, a message is sent from the instrument cluster via the network communication link to the front electronic module (FEM). The FEM acknowledges the message and energizes the horn relay by grounding the horn relay coil which allows the dual note horn to sound.

Inspection and Verification

NOTE: The FEM and instrument cluster must be reconfigured upon replacement. Refer to Section 418-01 .

1. Verify the customer concern by operating the horn.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged horn • Damaged horn switch • Damaged horn relay • Damaged air bag sliding contact (14A664) C2	• Battery junction box (BJB) Fuses: ♦ 425 (40A) ♦ 422 (20A) • Central junction box (CJB) Fuses: ♦ 202 (5A) ♦ 213 (5A) ♦ 217 (5A) ♦ 220 (10A) • Auxiliary junction box (AJB) Fuse(s): ♦ 104 (15A)

	• Damaged circuitry • Damaged horn relay • Loose or corroded connections • Damaged air bag sliding contact (14A664)

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTIC TEST. If the diagnostic tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for instrument cluster, GO to Pinpoint Test B.
   - NO RESP/NOT EQUIP for FEM, GO to Pinpoint Test A.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the instrument cluster and FEM.

6. If the DTCs retrieved are related to the concern, go to the Instrument Cluster Diagnostic Trouble Code (DTC) Index or go to the FEM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

FEM Diagnostic Trouble Code (DTC) Index

FEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1319	Driver Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1327	Passenger Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1342	ECU Is Defective	FEM	CLEAR the DTC. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new FEM. REFER to Section 419-10 .
B1438	Wiper Mode Select Switch Circuit Failure	FEM	REFER to Section 501-16 .
B1446	Wiper Park Sense Circuit Failure	FEM	REFER to Section 501-16 .
B1479	Wiper Washer Fluid Level Sensor Circuit Failure	FEM	REFER to Section 501-16 .
B1499	Lamp Turn Signal Left Circuit Failure	FEM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1503	Lamp Turn Signal Right Circuit Failure	FEM	REFER to Section 417-01 .

B1505	Lamp Turn Signal Right Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1519	Hood Switch Circuit Failure	FEM	REFER to Section 419-01A .
B1567	Lamp Headlamp High Beam Circuit Failure	FEM	REFER to Section 417-01 .
B1676	Battery Pack Voltage Out of Range	FEM	REFER to Section 414-00 .
B1794	Lamp Headlamp Low Beam Circuit Failure	FEM	REFER to Section 417-01 .
B2214	Window Passenger Front Up Switch Short to Battery	FEM	REFER to Section 501-11 .
B2215	Window Passenger Front Down Switch Short to Battery	FEM	REFER to Section 501-11 .
B2312	Mirror Passenger Horizontal Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2316	Mirror Passenger Vertical Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2442	Intrusion Sensor Fault	FEM	REFER to Section 419-01A .
B2477	Module Configuration Failure	FEM	REFER to Section 418-01 .
C1284	Oil Pressure Switch Failure	FEM	REFER to Section 413-01 .
C1446	Brake Switch Circuit Failure	FEM	REFER to Section 417-01 .
C1924	VAPS Solenoid Actuator Output Circuit Short to Ground	FEM	REFER to Section 211-00 .
C1925	VAPS Solenoid Actuator Return Circuit Failure	FEM	REFER to Section 211-00 .
U1027	SCP (J1850) Invalid or Missing Data for Engine RPM	PCM	CARRY OUT the PCM self-test.
U1041	SCP (J1850) Invalid or Missing Data Vehicle Speed	ABS	CARRY OUT the ABS self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission/ Transaxle/PRNDL	PCM	CARRY OUT the PCM self-test.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the ICM self-test.
U1222	SCP (J1850) Invalid or Missing Data for Interior Lamps	ICM	CARRY OUT the ICM self-test.
U1227	SCP (J1850) Invalid or Missing Data for Body Status Request	ICM	CARRY OUT the ICM self-test.

Instrument Cluster Diagnostic Trouble Code (DTC) Index

Instrument Cluster Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1201	Fuel Sender Circuit Failure	ICM	REFER to Section 413-01 .
B1205	EIC Switch-1 Assembly Circuit Failure	ICM	REFER to Section 413-01 .

B1209	EIC Switch-2 Assembly Circuit Failure	ICM	REFER to Section 413-01 .
B1213	Anti-Theft Number of Programmed Keys Is Below Minimum	ICM	REFER to Section 419-01B .
B1246	Dim Panel Potentiometer Switch Circuit Failure	ICM	REFER to Section 413-00 .
B1342	ECU Is Defective	ICM	CLEAR and DOCUMENT the DTCs. CARRY OUT the instrument cluster Self-Test. INSTALL a new instrument cluster if DTC B1342 is retrieved again. REFER to Section 413-01 .
B1352	Ignition Key-In Circuit Failure	ICM	REFER to Section 211-05 .
B1470	Lamp Headlamp Input Circuit Failure	ICM	REFER to Section 417-01 .
B1492	Ignition Cylinder Sensor Open Circuit	ICM	REFER to Section 419-01B .
B1567	Lamp Headlamp High Beam Circuit Failure	ICM	REFER to Section 417-01 .
B1600	PATS Ignition Key Transponder Signal Is Not Received	ICM	REFER to Section 419-01B .
B1601	PATS Received Incorrect Key-Code From Ignition Key Transponder	ICM	REFER to Section 419-01B .
B1602	PATS Received Invalid Format of Key-Code From Ignition Key Transponder	ICM	REFER to Section 419-01B .
B1676	Battery Pack Voltage Out of Range	ICM	REFER to Section 413-01 .
B1681	PATS Transceiver Module Signal Is Not Received	ICM	REFER to Section 419-01B .
B1689	Autolamp Delay Circuit Failure	ICM	REFER to Section 417-01 .
B1875	Turn Signal / Hazard Switch Signal Circuit Failure	ICM	REFER to Section 417-01 .
B2103	Antenna Not Connected	ICM	REFER to Section 419-01B .
B2139	Data Mismatch (Receive Data Does Not Match What Was Expected)	ICM	REFER to Section 419-01A .
B2141	NVM Configuration Failure	ICM	REFER to Section 418-01 .
B2143	NVM Memory Failure	ICM	REFER to Section 413-01 .
B2162	Data Mismatch #2 (receive data does not match what was expected)	ICM	REFER to Section 419-01B .
B2328	Column Reach Feedback Potentiometer Circuit Failure	ICM	REFER to Section 211-04 .
B2332	Column Tilt Feedback Potentiometer Circuit Failure	ICM	REFER to Section 211-04 .
B2351	Steering Column Switch Circuit Failure	ICM	REFER to Section 211-04 .
B2431	Transponder Programming Failed	ICM	REFER to Section 419-01A .

B2472	Fog Lamp Switch Failure	ICM	REFER to Section 417-01 .
B2477	Module Configuration Failure	ICM	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission/ Transaxle/PRNDL	PCM	CARRY out the PCM self-test.
U1073	SCP (J1850) Invalid or Missing Data for Engine Coolant Fluid Temperature	PCM	CARRY OUT the PCM self-test.
U1123	SCP (J1850) Invalid or Missing Data for Odometer Rolling Count	ABS	CARRY OUT the ABS self-test.
U1131	SCP (J1850) Invalid or Missing Data for Fuel System	ICM	REFER to Section 413-01 .
U1147	SCP (J1850) Invalid or Missing Data for Vehicle Security System	PCM	CARRY OUT the PCM self-test.

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE FRONT ELECTRONIC MODULE (FEM)

PINPOINT TEST B: NO COMMUNICATION WITH THE INSTRUMENT CLUSTER

PINPOINT TEST C: THE HORN DOES NOT SOUND

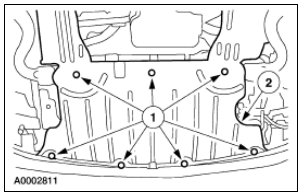
PINPOINT TEST D: THE HORN SOUNDS CONTINUOUSLY

Horn

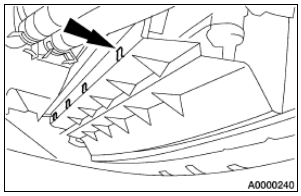
Removal and Installation

1. Raise and support the vehicle. For additional information, refer to Section 100-02 .

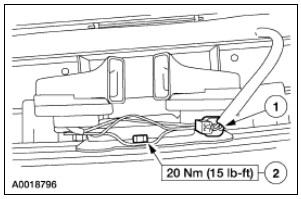
2. Remove the front splash shield.
    1. Remove the bolts.
    2. Remove the front splash shield.



3. Remove the air deflector shield.



4. Remove the horn.
    1. Disconnect the electrical connector.
    2. Remove the bolt.



5. To install, reverse the removal procedure.

Horn Switch

Removal and Installation

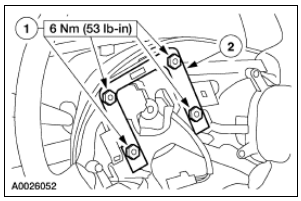
1. Remove the driver air bag module. Refer to Section 501-20B .

2. **NOTE:** The diagnostic tool has been removed from the art for clarity.

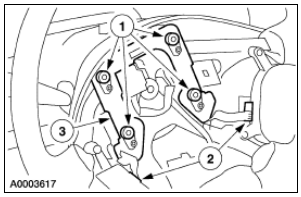
   NOTE: The four horn switch springs are not attached. To avoid losing the springs use caution when removing the horn switch.

   Remove the horn switch pad.

   1. Remove the bolts.
   2. Remove the horn switch pad.



3. Remove the horn switch.
   1. Remove the springs.
   2. Disconnect the steering wheel controls.
   3. Remove the horn switch.



4. **NOTE:** To provide correct tension between the horn pad and horn switch, install the yellow horn switch springs at the bottom and the silver horn switch springs at the top.

   To install, reverse the removal procedure.

Information And Message Center

The message center display is a green vacuum fluorescent, fixed format display. The message center display is integrated within the instrument cluster (10849) and cannot be replaced separately, refer to Section 413-01 . The message center is controlled by the four message center switches (FUEL, RESET, STATUS, and SETUP). Refer to the owner literature for more information.

Information And Message Center

Refer to Wiring Diagrams Cell 66 , for schematic and connector information.

Special Tool(s)

 ST1137-A	73 III Automotive Meter or equivalent 105-R0057
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Principles of Operation

NOTE: The instrument cluster (IC), message center (MC), front electronic module (FEM), rear electronic module (REM), remote emergency satellite cellular unit (RESCU), anti-lock braking system/traction control/stability assist module (ABS/TC), and the driver door module (DDM) must be reconfigured upon replacement. Refer to Section 418-01 .

The message center is part of the instrument cluster (10849). It uses a vacuum fluorescent display. The message center communicates with the PCM, FEM, REM, IC, ABS/TC/stability assist module, DDM, and the RESCU module over the SCP network. As a technician it is important to understand:

- where the input (command) originates from.
- all information (messages) necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input (message) control the output of the feature, or does it output a message over the SCP communication network to another module?
- which module controls the output of the feature.

Display Information

The display modes are:

- fuel (average fuel economy, distance to empty)
- setup
- system status
- warning
- temporary alert

The message center information can be selected by depressing any of the following four buttons:

- FUEL
- RESET
- SETUP
- STATUS

The setup display and the status display will time-out and default to the fuel blank display function. The temporary alert display will interrupt the current display to show the status of an event that has just happened. The warning display interrupts the current display until cleared or reset by the driver.

Status Displays

The status displays are timed modes and default back to the fuel blank display function. The status display modes are:

- oil life %
- AC air filter life %
- charging system
- engine temperature
- brake fluid level
- washer fluid level
- driver door
- passenger door
- driver rear door
- passenger rear door
- luggage compartment lid
- front turn lamps
- rear turn lamps
- stoplamps
- tail lamps
- traction control
- advance trac

Setup Displays

The setup displays are timed modes and default back to the fuel blank display function. The setup display modes are:

- language
- English/metric units
- autolocks on, autolocks off
- lock chirp on, lock chirp off
- easy entry on, easy entry off

Warning Messages

The warning messages can interrupt the display until cleared or reset by the driver. The warning messages are:

- engine temperature
- oil life
- check charging system
- transmission errors
- low washer fluid level
- low brake fluid
- low fuel
- driver door
- passenger door
- driver rear door
- passenger rear door
- luggage compartment lid

- stoplamps
- front turn lamps
- rear turn lamps
- rear tail lamps
- check fuel cap

The warning messages will display when the ignition switch is turned to ON and a fault occurs in a system. The message can be cleared by pressing the RESET button.

Temporary Alert Messages

The temporary alert display will interrupt the current display to show the status of an event that has just happened. The temporary alert messages are:

- autolamp delay
- memory recall/save
- traction control
- advance trac
- RESCU message

Inspection and Verification

NOTE: The IC, MC, REM, and FEM must be reconfigured upon replacement. Refer to Section 418-01 .

1. Verify the customer concern by operating the instrument cluster and message center to duplicate the condition by observing the indicators, warning displays, and gauges to determine if they are operating correctly with the ignition switch:

- in RUN with the engine off
- in START before the ignition switch is released
- in RUN with the engine running

2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Low washer fluid level • Damaged fuel tank • Low engine coolant level • Damaged accessory drive belt • Low engine oil level • Low brake fluid level	• Central junction box (CJB) Fuse(s): ♦ 204 (5A) ♦ 205 (5A) ♦ 207 (5A) ♦ 213 (5A) ♦ 217 (5A) ♦ 219 (15A) ♦ 220 (10A) ♦ 224 (5A) ♦ 229 (5A) ♦ 230 (5A)

	• Battery junction box (BJB) Fuse(s): ♦ 422 (20A) ♦ 425 (40A) ♦ 430 (30A) • Damaged circuitry • Damaged connectors • Damaged switches or sensors

3. If the inspection reveals obvious concern(s) that can be readily identified, repair as necessary.

4. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

5. If the diagnostic tool still does not communicate with the vehicle, refer to the New Generation STAR Tester manual.

6. Carry out the DATA LINK DIAGNOSTIC TEST. If the diagnostic tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for instrument cluster or message center (MCM), go to Pinpoint Test A.
   - NO RESP/NOT EQUIP for FEM, go to Pinpoint Test B.
   - NO RESP/NOT EQUIP for REM, go to Pinpoint Test C.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the instrument cluster.

7. If the DTCs retrieved are related to the concern, go to the Message Center Module Diagnostic Trouble Code (DTC) Index, Instrument Cluster Diagnostic Trouble Code (DTC) Index, FEM Diagnostic Trouble Code (DTC) Index, REM Diagnostic Trouble Code (DTC) Index or RESCU Diagnostic Trouble Code (DTC) Index to continue diagnostics.

8. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

Message Center Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1205	Message Center Switch Assembly Circuit Failure	MCM	GO to Pinpoint Test D .
B1342	ECU Defective	MCM	**NOTE:** The message center is part of the instrument cluster. CLEAR and DOCUMENT the DTCs. CARRY OUT the message center self-test. INSTALL a new instrument cluster if the DTC B1342 is retrieved again. REFER to

			Section 413-01 .
B1676	Battery Voltage Out of Range	MCM	GO to Pinpoint Test A .
B2477	Module Configuration Failure	MCM	REFER to Section 418-01 .
U1020	SCP (J1850) Invalid or Missing Data for Engine Air Conditioning Clutch	FEM	CARRY OUT the FEM self-test.
U1027	SCP (J1850) Invalid or Missing Data for Engine RPM	PCM	CARRY OUT the PCM self-test.
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ICM	CARRY OUT the instrument cluster self-test.
U1053	SCP (J1850) Invalid or Missing Data for Steering / Steering Wheel	PCM	CARRY OUT the PCM self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission / Transaxle / PRNDL	PCM	CARRY OUT the PCM self-test.
U1065	SCP (J1850) Invalid or Missing Data for Primary Id $41	ABS	CARRY OUT the ABS self-test.
U1073	SCP (J1850) Invalid or Missing Data for Engine Coolant	PCM	CARRY OUT the PCM self-test.
U1075	SCP (J1850) Invalid or Missing Data for Engine Oil	FEM	REFER to Section 413-01 .
U1083	SCP (J1850) Invalid or Missing Data for Engine Systems Other	PCM	CARRY OUT the PCM self-test.
U1098	SCP (J1850) Invalid or Missing Data for Vehicle Speed Control	PCM	CARRY OUT the PCM self-test.
U1117	SCP (J1850) Invalid or Missing Data for Electrical Energy Management	FEM	CARRY OUT the FEM self-test.
U1123	SCP (J1850) Invalid or Missing Data for Odometer	ABS, stability assist module, TC	CARRY OUT the ABS, stability assist module, and TC self-test.
U1135	SCP (J1850) Invalid or Missing Data for Ignition Switch / Starter	ICM	CARRY OUT the instrument cluster self-test.
U1136	SCP (J1850) Invalid or Missing Data for Telltales	FEM, PCM	CARRY OUT the FEM and PCM self-test.
U1180	SCP (J1850) Invalid or Missing Data for	DDM	CARRY OUT the DDM self-test.

	Personalization (Memory) Features		
U1181	SCP (J1850) Invalid or Missing Data for Personalization (Memory) Features	DDM	CARRY OUT the DDM self-test.
U1199	SCP (J1850) Invalid or Missing Data for External Access (Doors)	REM, FEM, DDM	CARRY OUT the REM, FEM, and DDM self-test.
U1217	SCP (J1850) Invalid or Missing Data for External Lamp Outage	FEM, REM	CARRY OUT the FEM and REM self-test.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the instrument cluster self-test.
U1222	SCP (J1850) Invalid or Missing Data for Interior Lamps	ICM	CARRY OUT the instrument cluster self-test.

Instrument Cluster Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1201	Fuel Sender Circuit Failure	ICM	REFER to Section 413-01 .
B1205	EIC Switch-1 Assembly Circuit Failure	ICM	REFER to Section 413-01 .
B1209	EIC Switch-2 Assembly Circuit Failure	ICM	REFER to Section 413-01 .
B1213	Anti-Theft Number of Programmed Keys Is Below Minimum	ICM	REFER to Section 419-01B .
B1246	Dim Panel Potentiometer Switch Circuit Failure	ICM	REFER to Section 413-00 .
B1342	ECU Is Defective	ICM	CLEAR and DOCUMENT the DTCs. CARRY OUT the instrument cluster Self-Test. INSTALL a new instrument cluster if DTC B1342 is retrieved again. REFER to Section 413-01 .
B1352	Ignition Key-In Circuit Failure	ICM	REFER to Section 413-09 .
B1470	Lamp Headlamp Input Circuit Failure	ICM	REFER to Section 417-01 .
B1567	Lamp Headlamp High Beam Circuit Failure	ICM	REFER to Section 417-01 .
B1600	PATS Ignition Key Transponder Signal Is Not Received	ICM	REFER to Section 419-01B .
B1601	PATS Received Incorrect Key-Code From Ignition Key Transponder	ICM	REFER to Section 419-01B .
B1602	PATS Received Invalid Format of Key-Code From Ignition Key Transponder	ICM	REFER to Section 419-01B .
B1676	Battery Pack Voltage Out of Range	ICM	REFER to Section 413-01 .
B1681	PATS Transceiver Module Signal Is Not	ICM	REFER to Section 419-01B .

	Received		
B1689	Autolamp Delay Circuit Failure	ICM	REFER to Section 417-01 .
B1875	Turn Signal / Hazard Switch Signal Circuit Failure	ICM	REFER to Section 417-01 .
B2103	Antenna Not Connected	ICM	REFER to Section 419-01B .
B2139	Data Mismatch (Received Data Does Not Match What Was Expected)	ICM	REFER to Section 419-01A .
B2141	NVM Configuration Failure	ICM	REFER to Section 419-01B .
B2143	NVM Memory Failure	ICM	REFER to Section 419-01B .
B2162	Security Data Mismatch #2 (Received Data Does Not Match What Was Expected)	ICM	REFER to Section 419-01B .
B2328	Column Reach Feedback Potentiometer Circuit Failure	ICM	REFER to Section 211-04 .
B2332	Column Tilt Feedback Potentiometer Circuit Failure	ICM	REFER to Section 211-04 .
B2351	Steering Column Switch Circuit Failure	ICM	REFER to Section 211-04 .
B2431	Transponder Programming Failed	ICM	REFER to Section 419-01A .
B2472	Fog Lamp Switch Failure	ICM	REFER to Section 417-01 .
B2477	Module Configuration Failure	ICM	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS, ABS/TC, stability assist module	CARRY OUT the ABS, ABS/TC, or stability assist self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/PRNDL	PCM	CARRY OUT the PCM self-test.
U1073	SCP (J1850) Invalid or Missing Data for Engine Coolant Fluid Temperature	PCM	CARRY OUT the PCM self-test.
U1123	SCP (J1850) Invalid or Missing Data for Odometer Rolling Count	ABS, ABS/TC, stability assist module	CARRY OUT the ABS, ABS/TC, stability assist module self-test.
U1147	SCP (J1850) Invalid or Missing Data for Vehicle Security System	PCM	CARRY OUT the PCM self-test.

FEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1319	Driver Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1327	Passenger Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1342	ECU Is Defective	FEM	CLEAR the DTC. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new FEM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test.
B1438	Wiper Mode Select Switch Circuit Failure	FEM	REFER to Section 501-16 .

B1446	Wiper Park Sense Circuit Failure	FEM	REFER to Section 501-16 .
B1479	Wiper Washer Fluid Level Sensor Circuit Failure	FEM	REFER to Section 413-01 .
B1499	Lamp Turn Signal Left Circuit Failure	FEM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1503	Lamp Turn Signal Right Circuit Failure	FEM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1519	Hood Switch Circuit Failure	FEM	REFER to Section 419-01A .
B1567	Lamp Headlamp High-Beam Circuit Failure	FEM	REFER to Section 417-01 .
B1676	Battery Pack Voltage Out of Range	FEM	REFER to Section 414-00 .
B1794	Lamp Headlamp Low-Beam Circuit Failure	FEM	REFER to Section 417-01 .
B2214	Window Passenger Front Up Switch Short to Battery	FEM	REFER to Section 501-11 .
B2215	Window Passenger Front Down Switch Short to Battery	FEM	REFER to Section 501-11 .
B2312	Mirror Passenger Horizontal Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2316	Mirror Passenger Vertical Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2443	Powertrain Performance Mode Switch Circuit Failure	FEM	Not Used
B2477	Module Configuration Failure	FEM	REFER to Section 418-01 .
C1284	Oil Pressure Switch Failure	FEM	REFER to Section 413-01 .
C1446	Brake Switch Circuit Failure	FEM	REFER to Section 413-01 .
C1924	VAPS Solenoid Actuator Output Circuit Short to Ground	FEM	REFER to Section 211-00 .
C1925	VAPS Solenoid Actuator Return Circuit Failure	FEM	REFER to Section 211-00 .
U1027	SCP (J1850) Invalid or Missing Data for Engine RPM	PCM	CARRY OUT the PCM self-test.
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission / Transaxle / PRNDL	PCM	CARRY OUT the PCM self-test.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the ICM self-test.
U1222	SCP (J1850) Invalid or Missing Data for Interior Lamps	ICM	CARRY OUT the ICM self-test.

U1227	SCP (J1850) Invalid or Missing Data for Body Status Request	ICM	CARRY OUT the ICM self-test.

REM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1201	Fuel Sender Circuit Failure	REM	REFER to Section 413-01 .
B1300	Power Door Lock Circuit Failure	REM	REFER to Section 501-14B .
B1310	Power Door Unlock Circuit Failure	REM	REFER to Section 501-14B .
B1331	Deck Lid Ajar Rear Door Circuit Failure	REM	REFER to Section 417-02 .
B1335	Door Ajar RR Circuit Failure	REM	REFER to Section 417-02 .
B1342	ECU Is Defective	REM	CLEAR the DTC. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new REM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test.
B1483	Brake Pedal Input Circuit Failure	REM	REFER to Section 417-01 .
B1499	Lamp Turn Signal Left Circuit Failure	REM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	REM	REFER to Section 417-01 .
B1503	Lamp Turn Signal Right Circuit Failure	REM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	REM	REFER to Section 417-01 .
B1551	Deck Lid Release Circuit Failure	REM	REFER to Section 501-14B .
B1571	Door Ajar LR Circuit Failure	REM	REFER to Section 417-02 .
B1676	Battery Pack Voltage Out of Range	REM	REFER to Section 414-00 .
B2172	Inertia Switch Input Circuit Open	REM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
B2174	Window Driver Rear Remote Up Switch Short to Battery	REM	REFER to Section 501-11 .
B2178	Window Driver Rear Remote Down Switch Short to Battery	REM	REFER to Section 501-11 .
B2190	Window Passenger Rear Remote Up Switch Short to Battery	REM	REFER to Section 501-11 .
B2194	Window Passenger Rear Remote Down Switch Short to Battery	REM	REFER to Section 501-11 .
B2477	Module Configuration Failure	REM	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/ PRNDL	PCM	CARRY OUT the PCM self-test.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the ICM self-test.

RESCU Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By	Action
B1216	Emergency Roadside Assistance Switch Circuit Short to Ground	RESCU Module	REFER to Section 419-05 .
B1342	ECU is Defective	RESCU Module	CLEAR the DTCs. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new RESCU module. For additional information, REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test.
B1871	Passenger Air Bag Disable Module Fault	RESCU Module	REFER to Section 419-05 .
B1874	Cellular Phone Handset Not Present (Phone transceiver is connected but not responding to any RESCU query)	RESCU Module	REFER to Section 419-05 .
B1893	GPS Antenna Open Circuit	RESCU Module	REFER to Section 419-05 .
B2102	Antenna Circuit Short to Ground (GPS)	RESCU Module	REFER to Section 419-05 .
B2141	NVM Configuration Failure [No/invalid telephone number(s) present]	RESCU Module	CLEAR the DTCs. CARRY OUT RESCU on-demand self-test. If DTC B2141 is retrieved, INSTALL a new RESCU module. For additional information, REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test.
B2477	Module Configuration Failure (No/invalid VIN present or RESCU configuration error)	RESCU Module	CHECK the RESCU module configuration. For additional information, REFER to Section 418-01 .

PCM Diagnostic Trouble Code (DTC) Index

DTC	Description	DTC Caused By	Action
P0457	Fuel Fill Cap Off	PCM	GO to Pinpoint Test M .

For a complete list of PCM DTCs, refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE INSTRUMENT CLUSTER MODULE/MESSAGE CENTER MODULE

PINPOINT TEST B: NO COMMUNICATION WITH THE FRONT ELECTRONIC MODULE

PINPOINT TEST C: NO COMMUNICATION WITH REAR ELECTRONIC MODULE

PINPOINT TEST D: NO COMMUNICATION WITH THE REMOTE EMERGENCY SATELLITE CELLULAR UNIT (RESCU)

PINPOINT TEST E: THE MESSAGE CENTER IS NOT OPERATING CORRECTLY

PINPOINT TEST F: THE MESSAGE CENTER SWITCH IS NOT OPERATING CORRECTLY

PINPOINT TEST G: THE INDICATOR DOES NOT OPERATE CORRECTLY LOW FUEL LEVEL DISPLAY

PINPOINT TEST H: THE INDICATOR IS INOPERATIVE OIL LIFE STATUS, AC FILTER LIFE

PINPOINT TEST I: LAMPOUT WARNING INDICATOR IS INOPERATIVE

PINPOINT TEST J: THE INDICATOR DOES NOT OPERATE CORRECTLY WASHER FLUID LEVEL DISPLAY

PINPOINT TEST K: THE INDICATOR DOES NOT OPERATE CORRECTLY LOW BRAKE FLUID LEVEL DISPLAY

PINPOINT TEST L: DATA STATUS MESSAGE IS DISPLAYED DOOR AJAR DISPLAY

PINPOINT TEST M: DATA STATUS MESSAGE IS DISPLAYED CHECK FUEL CAP

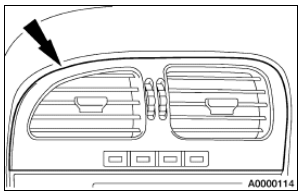
PINPOINT TEST A: NO COMMUNICATION WITH THE INSTRUMENT CLUSTER MODULE/MESSAGE CE

Switch Message Center

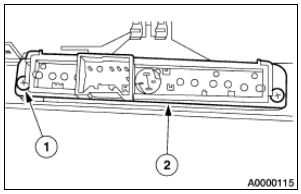
Removal and Installation

1. Disconnect the battery ground cable. Refer to Section 414-01

2. Remove the center A/C register finish panel.
   - Disconnect the electrical connector.



3. Remove the message center switch.
   1. Remove the screws.
   2. Remove the message center switch.
   - Install a new bulb if necessary.



4. **NOTE:** When the battery is disconnected and then reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.

   To install, reverse the removal procedure.

Warning Devices

NOTE: The key-in-ignition switch is an integral part of the ignition switch. For additional information, refer to Section 211-04 .

The warning device system consists of the following:

- key-in-ignition switch
- door ajar switch
- instrument cluster
- front electronic module (FEM)
- rear electronic module (REM)
- safety belt switch
- headlamp switch

Warning Devices

Refer to Wiring Diagrams Cell 66 , for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool
 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Inspection and Verification

1. Verify the customer concern by operating the system.

2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Door ajar switches • Key-in-ignition switch • Headlamp switch	• Central junction box (CJB) Fuses: ♦ 204 (5A) ♦ 213 (5A) ♦ 217 (5A) ♦ 219 (20A) ♦ 220 (10A) • Battery junction box (BJB) Fuses: ♦ 422 (20A) ♦ 425 (40A) • Circuitry. • Instrument cluster.

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If the diagnostic tool does not power up, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for instrument cluster (IC), go to Pinpoint Test A.
   - NO RESP/NOT EQUIP for restraint control module (RCM), refer to Section 501-20B .
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the IC and RCM.

6. If the DTCs retrieved from the RCM are related to the concern, refer to Section 501-20B . If the DTCs retrieved from the IC are related to the concern, go to the Instrument Cluster Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.

Instrument Cluster Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1352	Ignition Key-In Circuit Failure	ICM	GO to Pinpoint Test D .

NOTE: For a complete master list of all instrument cluster DTCs refer to Section 419-10 .

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE INSTRUMENT CLUSTER

PINPOINT TEST B: THE CHIME SOUNDS WHEN THE DRIVER DOOR IS AJAR (NO KEY IN IGNITION AND HEADLAMPS OFF)

PINPOINT TEST C: THE SAFETY BELT WARNING CHIME DOES NOT OPERATE CORRECTLY

PINPOINT TEST D: THE KEY-IN-IGNITION CHIME DOES NOT OPERATE CORRECTLY

PINPOINT TEST E: THE HEADLAMP ON REMINDER CHIME DOES NOT OPERATE CORRECTLY

PINPOINT TEST F: A CHIME DOES NOT OPERATE CORRECTLY AIR BAG WARNING CHIME

PINPOINT TEST G: A CHIME DOES NOT OPERATE CORRECTLY FAIL SAFE COOLING CHIME

PINPOINT TEST H: A CHIME DOES NOT OPERATE CORRECTLY TURN SIGNAL WARNING TONE

Belt Minder Deactivating/Activating

Preparation

1. Before deactivating/activating the belt minder, set the parking brake.
2. Place the transmission range selector lever in P (PARK) (automatic transmission) or the NEUTRAL position (manual transmission).
3. Place the ignition switch in the OFF position.
4. Close all the vehicle doors.
5. Unbuckle the driver safety belt.
6. Place the parking lamps/headlamps switch in the OFF position.

Deactivating/Activating

1. Start with the ignition OFF and the driver and passenger safety belts unbuckled.
2. Turn the ignition to RUN (it is not required to start the vehicle.)
3. Wait until the seatbelt warning lamp turns off (approximately one minute.)
4. Buckle then unbuckle the driver or passenger seatbelt three times, ending in the unbuckled state. Step 4 must be completed within 60 seconds.
5. After Step 4 is complete the airbag warning lamp will be turned on for three seconds.
6. After the airbag warning lamp turns off, buckle/then unbuckle the safety belt again. This will enable the beltminder if it is currently disabled, or will disable the beltminder if it is currently enabled.
7. Confirmation of enabling the beltminder is provided to the customer by the airbag warning lamp flashing four times per second for three seconds, followed by three seconds again.
8. Confirmation of disabling the beltminder is provided to the customer by the airbag warning lamp flashing four times per second for three seconds.
9. Customer programming of the beltminder is automatically exited after completion of the customer confirmation.
10. The beltminder will automatically exit the programming mode without changing its enable status if Step 6 does not occur within 10 seconds of the end of Step 4.
11. Performing Steps 1-12 using only the driver safety belt will permanently enable/ disable the driver beltminder feature.

12. Performing Steps 1-12 using only the passenger safety belt will permanently enable/disable the passenger belminder feature.

13. Only one side (driver or passenger) can be enabled/disabled per key cycle. While programming the driver side, any activity on the passenger safety belt will abort the programming sequence. While programming the passenger side, any activity on the driver safety belt will terminate the programming sequence.

14. The programming sequence will abort if a system fault occurs that requires the illumination of the restraints indicator lamp (RIL) at any time during programming or confirmation.

-- E --

Electronic Compass
DESC & OPER: Electronic Compass

DIAG & TEST: Electronic Compass

Section Table of Contents

Electronic Engine Controls

DESC & OPER: Electronic Engine Controls

DIAG & TEST: Electronic Engine Controls

Section Table of Contents

Electronic Leak Detection

Engine and Radiator Flushing

Engine Cooling

DESC & OPER: Engine Cooling

DIAG & TEST: Engine Cooling

Section Table of Contents

Engine Emission Control

DESC & OPER: Engine Emission Control

DIAG & TEST: Engine Emission Control

Section Table of Contents

Engine Front Cover

IN-VEH REP: Engine - 3.0L (4V)

IN-VEH REP: Engine - 3.9L

Engine Ignition - 3.0L (4V), Section Table of Contents

Engine Ignition - 3.9L, Section Table of Contents

Engine Ignition

DESC & OPER: Engine Ignition - 3.0L (4V)

DESC & OPER: Engine Ignition - 3.9L

DIAG & TEST: Engine Ignition - 3.0L (4V)

DIAG & TEST: Engine Ignition - 3.9L

Engine Mount - LH

Engine Mount - RH

Engine Mount

Engine System - General Information, Section Table of Contents

Engine - 3.0L (4V), Section Table of Contents

Engine - 3.9L, Section Table of Contents

Engine

ASSEM: Engine - 3.0L (4V)

ASSEM: Engine - 3.9L

DESC & OPER: Engine System - General Information

DESC & OPER: Engine - 3.0L (4V)

DESC & OPER: Engine - 3.9L

DIAG & TEST: Engine System - General Information

DIAG & TEST: Engine - 3.0L (4V)

DIAG & TEST: Engine - 3.9L

DISASSEM: Engine - 3.0L (4V)

DISASSEM: Engine - 3.9L

INST: Engine - 3.0L (4V)

INST: Engine - 3.9L

REM: Engine - 3.0L (4V)

REM: Engine - 3.9L

Entertainment System - General Information, Section Table of Contents

Evaporative Emission Canister Purge Valve

Evaporative Emission Canister Vent Solenoid

Evaporative Emission Canister

Evaporative Emission Repair Verification Drive Cycle

Evaporative Emission System Leak Test

Evaporative Emissions

DESC & OPER: Evaporative Emissions

DIAG & TEST: Evaporative Emissions

Section Table of Contents

Evaporator Core

Exhaust Gas Recirculation (EGR) Vacuum Regulator Solenoid - 3.0L

Exhaust Gas Recirculation (EGR) Vacuum Regulator Solenoid - 3.9L

Exhaust Gas Recirculation (EGR) Valve

Exhaust Heat Shield - Catalytic Converter

Exhaust Heat Shield - Front

Exhaust Heat Shield - Underbody

Exhaust Manifold LH

IN-VEH REP: Engine - 3.0L (4V)

IN-VEH REP: Engine - 3.9L

Exhaust Manifold RH

IN-VEH REP: Engine - 3.0L (4V)

IN-VEH REP: Engine - 3.9L

Exhaust Manifold To Exhaust Gas Recirculation (EGR) Valve Tube - 3.0L

Exhaust Manifold To Exhaust Gas Recirculation (EGR) Valve Tube - 3.9L

Exhaust Manifold - Inspection

Exhaust System Neutralizing

Exhaust System

DESC & OPER: Exhaust System

DIAG & TEST: Exhaust System

Section Table of Contents

Extension Housing Gasket

Extension Housing Seal

Exterior Lighting

DESC & OPER: Exterior Lighting

Section Table of Contents

Exterior Trim and Ornamentation, Section Table of Contents

External Controls

DESC & OPER: Automatic Transaxle/Transmission External Controls

DIAG & TEST: Automatic Transaxle/Transmission External Controls

General Specifications

Item	Specification
Battery	
Manufacturer	Motorcraft
Voltage	12 volts
Amps at -17.7°C (0°F) cold crank	650
Minutes-reserve capacity	130
Amps/hrs. -20 hour rate	72
Generator	
Current output	105 amps @ 6,000 gen rpm
Type	6G with internal voltage regulator
Pulley ratio	2.65:1 (3.0L); 2.78:1 (3.9L)

Charging System

This vehicle is equipped with a powertrain control module (PCM) controlled charging system. The PCM-controlled charging system is a system whereby the PCM determines the optimal voltage setpoint for the charging system and communicates this information to the voltage regulator. The PCM-controlled charging system is unique in that it has two unidirectional communication lines between the PCM and the generator/regulator. Both of these communication lines are pulse-width modulated. The generator communication (GEN COM) line communicates the desired setpoint from the PCM to the voltage regulator and the generator monitor (GEN MON) line communicates the generator load and error conditions to the PCM. The third pin on the voltage regulator, the A circuit pin, is a dedicated battery voltage sense line.

Circuit Description

B+ Output Terminal Circuit 30-BA6 (RD)

Generator output voltage is supplied through the battery positive (B+) output terminal on the rear of the generator to the battery and the electrical system.

Circuit 30-BA25 (RD)

This is the A terminal battery voltage sense circuit and is used to sense battery voltage. The circuit is used to supply current to the generator field (rotor) and to turn on the voltage regulator which determines generator output. This circuit is also used to turn the charging system warning indicator on if there is a fault in the charging system operation.

Circuit 10-BA25 (GY/RD)

This is the generator communication (GEN COM) circuit. The PCM determines the optimal voltage setpoint for the charging system and communicates this information to the voltage regulator via the GEN COM circuit.

Circuit 8-BA25 (WH/RD)

The generator monitor (GEN MON) circuit communicates the generator load and error conditions to the PCM.

Charging System

Refer to Wiring Diagrams Cell 12 for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2173-A	SABRE Premium Electrical System Tester 010-00736 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Inspection and Verification

⚠ WARNING: Batteries normally produce explosive gases. Therefore, do not allow flames, sparks or lighted substances to come near the battery. When charging or working near a battery, always shield your face and protect your eyes. Always provide ventilation. Failure to follow these instructions may result in personal injury.

⚠ WARNING: When lifting a plastic-cased battery, excessive pressure on the end walls could cause acid to spew through the vent caps, resulting in personal injury, damage to the vehicle or battery. Lift with a battery carrier or with your hands on opposite corners. Failure to follow these instructions may result in personal injury.

⚠ WARNING: Keep batteries out of the reach of children. Batteries contain sulfuric acid. Avoid contact with skin, eyes, or clothing. Also, shield your eyes when working near the battery to protect against possible splashing of the acid solution. In case of acid contact with skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If acid is swallowed, call a physician immediately. Failure to follow these instructions may result in personal injury.

1. Verify the customer concern by operating the engine to duplicate the concern.

2. Inspect to determine if one of the following mechanical or electrical concerns apply:

Visual Inspection Chart

Mechanical	Electrical

• Battery • Generator drive belt • Generator pulley	• Battery junction box (BJB) fuse: ♦ F415 (5A) • Central junction box (CJB) fuse: ♦ F217 (5A) • Circuitry • Charging warning indicator • Cables

3. If the inspection reveals obvious concerns that can be readily identified, repair as necessary. Check the generator sense Fuse F415 located in the battery junction box.

4. Measure the open circuit battery voltage. (Battery is located in the luggage compartment on the RH side). If the battery voltage is less than 12.0 volts, test and recharge the battery before continuing with diagnosis. Refer to Section 414-01 .

5. Check the operation of the charging system warning indicator lamp (instrument cluster). Normal operation is as follows:
   - With the ignition switch OFF, the charging system warning indicator should be OFF.
   - With the ignition switch in RUN and the engine off, the charging system warning indicator light should be on.
   - With the engine running, the charging system warning indicator light should be off.

6. Check the battery voltage before and after starting the engine to determine if the battery voltage increases. Refer to the Normal Charging System Voltages chart.

   Normal Charging System Voltages and Charging System Warning Indicator Operation

Key Position	30 BA25 (RD)	10 BA25 (GY/RD)	Generator B+ 30 BA6 (RD)	Battery	Engine to Battery Ground	Charging System Warning Indicator Operation
Key OFF	12 volts	0 volts	12 volts	12 volts	0 volts	Off
RUN-engine OFF	12 volts	1-3 volts	12 volts	12 volts	0 volts	Illuminated
RUN-engine running	13- 15V	13- 15V	13- 15V	13- 15V	0V	Off

7. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located under the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the vehicle selection cannot be entered:
   - check that the program card is correctly installed.
   - Check the connections to the vehicle.
   - check the ignition switch position. If the diagnostic tool still does not allow the vehicle selection to be entered, refer to the diagnostic tool manual.

8. If any PCM DTCs are retrieved, go to the PCM Index below to check if the codes retrieved are related to the charging system and continue diagnosis.

9. If no DTCs related to the charging system are retrieved, go to the Symptom Chart to continue diagnosis.

NOTE: DTC P1246 can be set by the loss of the communication lines, GEN COM Circuit 8-BA25 (WH/RD) and/or GEN MON Circuit 10-BA25 (GY/RD). However, the generator warning indicator lamp will not illuminate since the generator is self-regulating and will function normally.

Powertrain Control Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Action
P1246	System voltage failure	REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart

Symptom Chart

Pinpoint Tests

⚠ CAUTION: Do not make jumper connections except as directed. Incorrect connections may damage the voltage regulator test terminals, fuses or fuse links.

⚠ CAUTION: Do not allow any metal object to come in contact with the generator housing and internal diode cooling fins.

NOTE: While carrying out any pinpoint test, disregard any DTCs set while following any specific pinpoint test. After the completion of any test, be sure to clear all codes in the PCM.

NOTE: All voltage measurements are referenced to the negative (-) battery post unless otherwise specified.

NOTE: When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the powertrain control module (PCM) relearns its fuel trim. The vehicle may need to be driven to relearn the strategy.

PINPOINT TEST A: BATTERY IS DISCHARGED OR VOLTAGE IS LOW

PINPOINT TEST B: CHARGING SYSTEM WARNING INDICATOR IS ON WITH THE ENGINE RUNNING (THE SYSTEM VOLTAGE DOES NOT INCREASE)

PINPOINT TEST C: THE SYSTEM OVERCHARGES (BATTERY VOLTAGE GREATER THAN 15 VOLTS)

PINPOINT TEST D: CHARGING SYSTEM WARNING INDICATOR IS ON WITH THE ENGINE RUNNING THE SYSTEM INCREASES VOLTAGE

PINPOINT TEST E: THE CHARGING SYSTEM WARNING INDICATOR IS OFF WITH THE IGNITION SWITCH IN THE RUN POSITION AND THE ENGINE IS OFF

PINPOINT TEST F: THE CHARGING SYSTEM WARNING INDICATOR LAMP FLICKERS OR IS INTERMITTENT

PINPOINT TEST G: THE GENERATOR IS NOISY

PINPOINT TEST H: RADIO INTERFERENCE

Component Tests

Battery Drain Testing

Check for current drains on the battery in excess of 30 milliamps (0.030 amp) with all the electrical accessories off and the vehicle at rest for at least 40 minutes. Current drains can be tested with the following procedure:

⚠ WARNING: Do not attempt this test on a lead-acid battery that has recently been recharged. Explosive gases can cause personal injury.

⚠ CAUTION: To prevent damage to the meter, do not crank the engine or operate accessories that draw more than 10A.

NOTE: Many electronic modules draw 5 mA or more continuously.

NOTE: Use an in-line digital ammeter between the battery negative post and its respective cable.

1. Make sure the engine/luggage compartments and interior fuse panels are accessible without turning on interior, underhood, or luggage compartment lights.
2. Drive the vehicle at least five minutes and over 48 km/h (30 mph) to turn on and activate vehicle systems.
3. Allow the vehicle to sit with the key off for at least 40 minutes to allow modules to time out/power down.
4. Connect a jumper wire between the negative battery cable and the negative battery post to prevent modules from resetting and to catch capacitive drains.
5. Disconnect the negative battery cable from the negative battery post without breaking the connection of the jumper wire.
6. Connect the battery tester between the negative battery cable and post. The meter must be capable of reading milliamps and should have a 10 amp capacity.

NOTE: It is very important that continuity is not broken between the battery post and the negative cable when connecting the meter. If this happens, the entire procedure must be repeated.

7. Remove the jumper wire.

NOTE: If the meter settings need to be switched or the test leads need to be moved to another jack, the jumper wire must be reinstalled to avoid breaking continuity.

8. Note the amperage draw. Draw will vary from vehicle to vehicle depending on the equipment package. Compare to a comparable vehicle for reference. No factory equipped vehicle should have more than a 30 mA draw (0.030 amp).

9. If the draw is found to be excessive, pull fuses from the central, auxiliary, and battery junction boxes one at a time and note the current reading. Do not reinstall fuses until you have finished testing.

10. If the current draw is still excessive, remove all of the fuses from all three junction boxes. Reinstall one fuse document the amperage draw and then remove the fuse. Repeat this procedure for every fuse in all three junction boxes. When the current level drops after pulling a fuse, the circuit containing the excessive draw has been located.

11. Check the Wiring Diagrams for any circuits that run from the battery without passing through either junction box. If the current draw is still excessive, disconnect these circuits until the draw is found. Also disconnect the generator electrical connections if the draw cannot be located. The generator may be internally shorted, causing current drain.

Generator On-Vehicle Tests

⚠ CAUTION: To prevent damage to the generator (10346), do not make jumper wire connections except as directed.

⚠ CAUTION: Do not allow any metal object to come in contact with the housing and the internal diode cooling fins with key on or off. A short circuit will result and burn out the diodes.

NOTE: Battery posts and cable clamps must be clean and tight for accurate meter indications.

1. Turn off all lamps and electrical components.

2. Place the vehicle in transmission range NEUTRAL and apply the parking brake.

3. Carry out the Load Test and No-Load Test according to the following component tests:

Generator On-Vehicle Tests Load Test

1. Switch the tester to the ammeter function.

2. Connect the positive and negative leads of the tester to the corresponding battery terminals.

3. Connect the current probe to the generator B+ output terminal, circuit 38 (BK/OG).

4. With the engine running at 2,000 rpm, adjust the tester load bank to determine the output of the generator.

5. With the engine running, turn the A/C on, the blower motor on high speed and the headlamps on high beam.

6. Increase the engine speed to approximately 2,000 rpm. The voltage should increase a minimum of 0.5 volt above the base voltage.
   - If the voltage does not increase as specified, refer back to the pinpoint test.
   - If the voltage increases as specified, the charging system is operating normally.

Generator On-Vehicle Tests No Load Test

1. Switch the tester to the voltmeter function.

2. Connect the voltmeter positive lead to the generator B+ terminal and the negative lead to ground.

3. Turn all electrical accessories off.

4. With the engine running at 2,000 rpm, check the generator output voltage. The voltage should be between 13.0 and 15.0 volts. If not, refer to the Symptom Chart.

5. Turn the A/C on, the blower motor on high speed and the headlamps on high beam.

6. The voltage should increase a minimum of 0.5 volt above the base voltage.
    - If the voltage does not increase as specified, refer back to the pinpoint test.
    - If the voltage increases as specified, the charging system is operating normally.

General Specifications

Item	Specification
Manufacturer	Motorcraft
Voltage	12 volt
Amps at -17.7°C (0°F) cold crank	650
Minutes-reserve capacity	130
Amps/hrs.-20 hour rate	72
Amps at -17.7°C (0°F) cold crank	750 (Europe only)
Minutes-reserve capacity	140 (Europe only)
Amps/hrs.-20 hour rate	78 (Europe only)
Battery location	Right rear of the luggage compartment
Lubricant	
Premium Long Life Grease XG-1-C or XG-1-K	ESA-M1C75-B

Torque Specifications

Description	Nm	lb-ft	lb-in
Battery ground cable	7		62
Battery positive cable	7		62
Battery hold-down clamp bolt at battery	8		71
Battery positive cable bolt at the power distribution box	12	9	
Battery negative cable bolt at the body (trunk)	12	9	
Battery tray bolts	30	22	
Battery positive cable nut at dash (interior/exterior)	12	9	
Battery positive cable nut at the starter solenoid	12	9	
Battery (ignition/start) wire nut at the starter solenoid	6		53
Battery positive cable nut at the power distribution box	12	9	
Battery cable protective tube bolts	6		53
Battery hold-down bolt at body	12	9	

Battery and Cables

Vehicles are equipped with a 12 volt maintenance-free battery (10655) which is located in the luggage compartment, next to the spare tire. The battery purges any battery gases to the outside of the vehicle by means of a vent hose. This vent hose must be attached at all times. New batteries must be of the same vented design.

The battery contains a built-in hydrometer. The hydrometer eye indication is as follows:

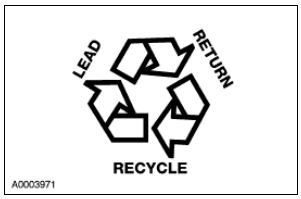
- A green dot means the battery is OK.
- A yellow dot, or a red dot, or when the green dot is not visible, means the battery needs to be charged.

If the battery has a cover/shield, make sure it is reinstalled after the battery has been cleaned or after a new battery has been installed.

The battery normally does not require additional water during its useful life. For longer, trouble-free operation, the top of battery should be clean and dry. Also, make certain the battery cables (14300, 14301) are always tightly fastened to the battery terminals.

If any terminal corrosion is detected, remove the cables from the terminals and clean with a wire brush. Battery acid can be neutralized with a solution of baking soda and water.

Always dispose of automotive batteries in a responsible manner. Follow your local authorized standards for disposal. Call your local authorized recycling center to find out more about recycling automotive batteries.



Battery

Special Tool(s)

 ST2442-A	Micro 490 Digital Battery Analyzer 162-00004

Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical or electrical damage.

   Visual Inspection Chart

Mechanical	Electrical
• Battery • Battery mounting	• Battery cables • Battery posts

3. If an obvious cause for a concern is found, correct the cause before proceeding to the next step.
4. If the fault is not visually evident, proceed to the pinpoint test.

Pinpoint Tests

PINPOINT TEST A: BATTERY CONDITION TEST

Battery Disconnect

⚠ WARNING: Batteries normally produce explosive gases which can cause personal injury. Therefore, do no allow flames, sparks or lighted substances to come near the battery, always shield your face and protect your eyes. Always provide ventilation.

⚠ WARNING: To avoid accidental deployment and possible injury, the backup power supply must be depleted before repairing or installing any front or side air bag supplemental restraint system (SRS) components and before repairing, installing, adjusting or striking components near the front or side air bag sensors, such as doors, instrument panel, console, door latches, strikers, seats and hood latches.

Please refer to the appropriate vehicle shop manual to determine location of the front air bag sensors.

To deplete the backup power supply energy, disconnect the battery ground cable and wait at least one minute. Be sure to disconnect auxiliary batteries and power supplies (if equipped).

⚠ WARNING: When lifting a battery, excessive pressure on the end walls could cause acid to spew through the vent caps, resulting in personal injury. Lift with a battery carrier or with your hands on opposite corners.

⚠ WARNING: Keep out of the reach of children. Batteries contain sulfuric acid. Avoid contact with skin, eyes or clothing. Also, shield your eyes when working near the battery to protect against possible splashing of the acid solution. In case of acid contact with the skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If acid is swallowed, call a physician immediately.

1. **NOTE:** When the battery is disconnected and reconnected, some abnormal drive symptoms may occur while the vehicle relearns its adaptive strategy. The vehicle may need to be driven to relearn its strategy.

   Disconnect the battery ground cable.

2. Disconnect the positive battery cable.

3. To install, reverse the removal procedure.

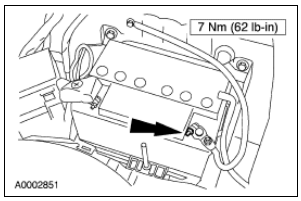
Battery

Removal and Installation

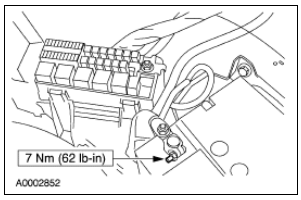
⚠ WARNING: Batteries normally produce explosive gases which can cause personal injury. Therefore, do not allow flames, sparks or lighted substances to come near the battery. When charging or working near a battery, always shield your face and protect your eyes. Always provide ventilation.

⚠ WARNING: Keep out of the reach of children. Batteries contain sulfuric acid. Avoid contact with skin, eyes or clothing. Also, shield your eyes when working near the battery to protect against possible splashing of the acid solution. In case of acid contact with the skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If acid is swallowed, call a physician immediately.

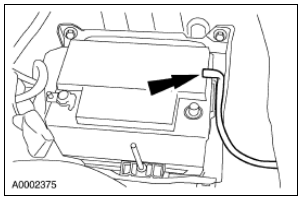
1. Disconnect the battery ground cable (14301).



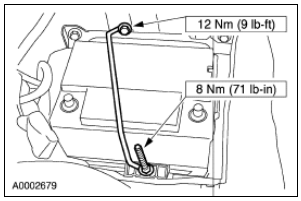
2. Disconnect the battery positive cable (14300).



3. Disconnect the battery vent tube.



4. Remove the bolt and spacer clamp (10B684).



5. **⚠ WARNING: When lifting a battery, excessive pressure on the end walls could cause acid to spew through the vent caps, resulting in personal injury. Lift with a battery carrier or with your hands on opposite corners.**

Remove the battery (10655).

6. **NOTE:** Because the vehicle's engine is electronically controlled by a computer, some control conditions are maintained by power from the battery. When the battery is disconnected or a new battery is installed, the engine must relearn its idle and fuel trim strategy for optimum driveability and performance. Let the engine idle for one minute. The relearning process will automatically complete itself as the vehicle is driven. The vehicle may need to be driven 16 km (10 miles). If the engine is not allowed to relearn its idle trim, the idle quality may be adversely affected until the idle trim is eventually relearned. Additionally, to account for customer driving habits and conditions, the automatic transmission must relearn its adaptive strategy. Optimal shifting will resume within a few hundred kilometers (miles) of operation. The clock and the preset radio stations must be reset once the battery is reconnected.

   To install, reverse the removal procedure.

Battery Tray

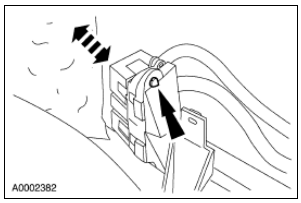
Removal and Installation

⚠ WARNING: Batteries normally produce explosive gases which can cause personal injury. Therefore, do not allow flames, sparks or lighted substances to come near the battery. When charging or working near a battery, always shield your face and protect your eyes. Always provide ventilation.

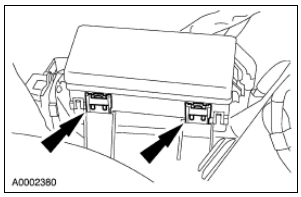
⚠ WARNING: Keep out of the reach of children. Batteries contain sulfuric acid. Avoid contact with skin, eyes or clothing. Also, shield your eyes when working near the battery to protect against possible splashing of the acid solution. In case of acid contact with the skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If acid is swallowed, call a physician immediately.

1. Remove the battery (10655). For additional information, refer to Battery .

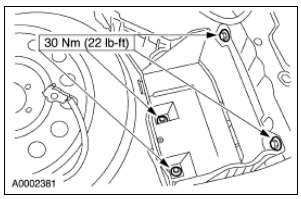
2. Remove the pin type retainer and position the fuse holder aside.



3. Remove the battery junction box (BJB) cover and remove the BJB from the battery tray (10764) and position it aside.



4. Remove the battery tray bolts and washers and the battery tray.



5. To install, reverse the removal procedure.

Battery Cables

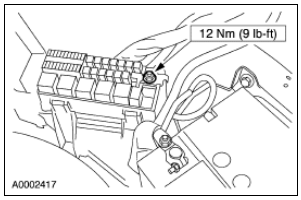
Removal and Installation

⚠ WARNING: Batteries normally produce explosive gases which can cause personal injury. Therefore, do not allow flames, sparks or lighted substances to come near the battery. When charging or working near a battery, always shield your face and protect your eyes. Always provide ventilation.

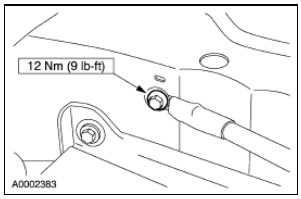
⚠ WARNING: Keep out of the reach of children. Batteries contain sulfuric acid. Avoid contact with skin, eyes or clothing. Also, shield your eyes when working near the battery to protect against possible splashing of the acid solution. In case of acid contact with the skin or eyes, flush immediately with water for a minimum of 15 minutes and get prompt medical attention. If acid is swallowed, call a physician immediately.

1. Remove the battery (10655). For additional information, refer to Battery .

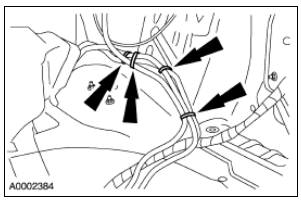
2. Remove the battery junction box (BJB) cover and remove the attachment nut securing the positive cable.



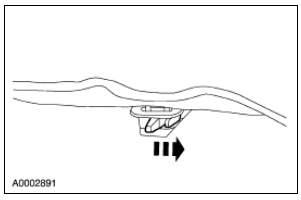
3. Remove the negative cable bolt.



4. Remove the harness clips from the cable in the luggage compartment.



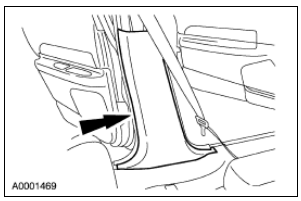
5. Remove the rear seat cushion.



6. Remove the upper RH B-pillar trim panel. For additional information, refer to Section 501-05 .

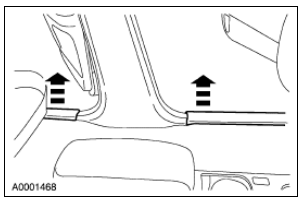
7. **NOTE:** LH shown, RH similar

   Remove the lower RH B-pillar trim cover and scuff plate screws .



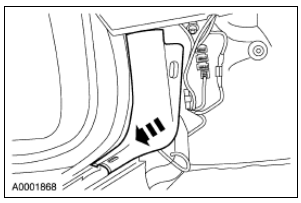
8. **NOTE:** LH shown, RH similar

   Remove the RH front and rear scuff plates.



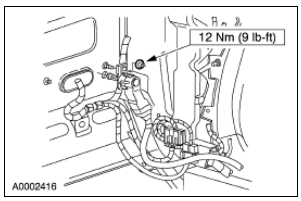
9. **NOTE:** LH shown, RH similar

   Remove the RH A-pillar lower trim panel and position aside the carpet to expose battery cable.

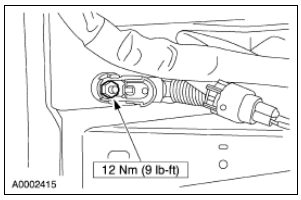


10. Remove the retaining tie straps and detach the cable forward past the rear seatback into the passenger compartment.

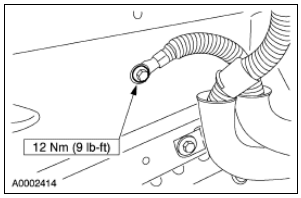
11. Remove the cable attachment cover and the nut at the dash through-bolt and remove the cable.



12. In the engine compartment at the dash panel, remove the protective cover and the nut.

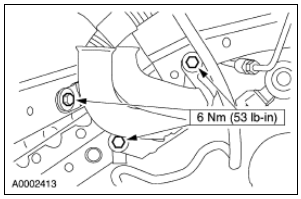


13. Remove the bolt at the body.



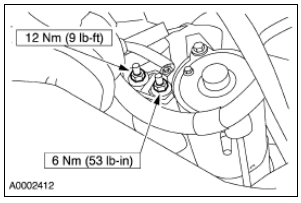
14. Remove the right front wheel well splash shield. For additional information, refer to Section 501-02 .

15. Remove the bolts at the harness protective tubes.



16. **NOTE:** 3.0L shown, 3.9L similar.

    Remove the cable protective cover at the starter solenoid and remove the nuts and the cable.



17. To install, reverse the removal procedure.

General Specifications

Item	Specification
Generator (10300) 3.0L	XR8U-AC
Generator (10300) 3.9L	XR8U-CD
Rating (gen. crank/rev.) 3.0/3.9L	(105 AMP/MAX)
Generator ratio, 3.0L	2.65:1
Generator ratio, 3.9L	2.78:1
Voltage regulator type (10316)	Electronic integral with generator

Torque Specifications

Description	Nm	lb-ft	lb-in
Generator positive cable nut	8		71
Generator mounting bolts, 3.0L	45	33	
Generator mounting bolts, 3.9L	48	35	
Generator expanding bushing and bolt assembly	20 + 90°	15 + 90°	

Generator

The generator has an internal voltage regulator that is not repaired separately. The generator and voltage regulator must be replaced as an assembly.

All 3.0L V6 manual transmission applications are equipped with a one-way clutch (OWC) in the generator pulley. The OWC pulley temporarily disengages the generator rotor from the front end accessory drive (FEAD) system during high acceleration/deceleration rates on the engine, which may increase belt life and decrease belt chirp. A new OWC pulley and generator/voltage regulator must be installed as an assembly.

Generator 3.0L

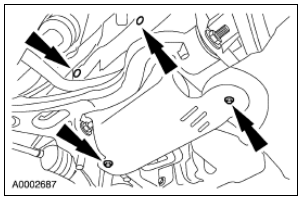
Removal and Installation

1. Disconnect the battery ground cable. Refer to Section 414-01 .

2. Relieve the accessory drive belt tension and move the belt off of the generator pulley. For additional information, refer to Section 303-05 .

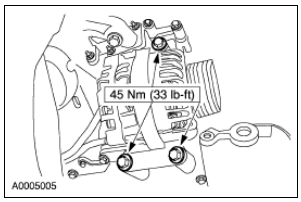
3. Raise the vehicle. For additional information, refer to Section 100-02 .

4. Remove the lower splash shield.
   - Remove the bolts.
   - Remove the pin-type retainers.

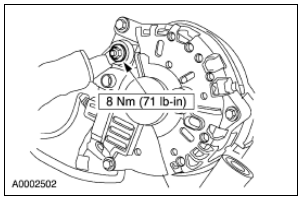


5. ⚠ **CAUTION: The generator must be supported by hand after removing the bolts and prior to disconnecting the electrical connectors or damage to the connectors or wiring could result.**

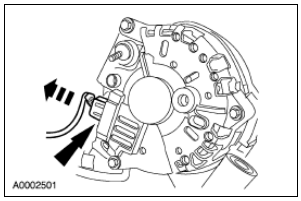
   Remove the bolts.



6. Disconnect the generator positive cable.
   - Carefully lower the generator to gain access to the battery generator cable nut.
   - Remove the nut and detach the cable.



7. Remove the generator.
   - Disconnect the electrical connector.
   - Remove the generator.

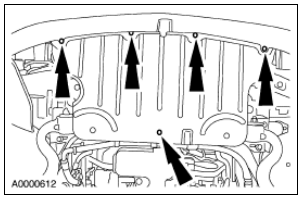


8. To install, reverse the removal procedure.

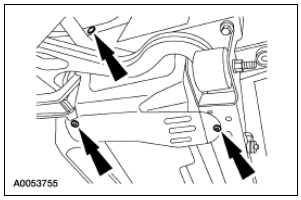
Generator 3.9L

Removal

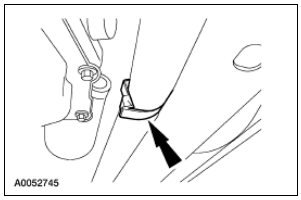
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the air intake tube. For additional information, refer to Section 303-12 .
3. Relieve the accessory drive belt tension and move the belt off the generator pulley. For additional information, refer to Section 303-05 .
4. Raise the vehicle. For additional information, refer to Section 100-02 .
5. Remove the front lower splash shield.



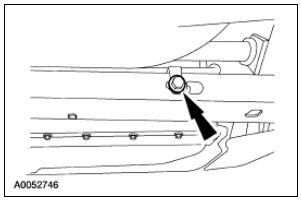
6. Remove the lower RH splash shield.



7. Remove the A/C suction line clip from the radiator core support.

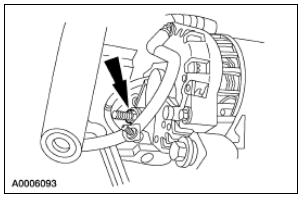


8. Remove the LH A/C suction line lower bracket bolt and position the bracket rearward.

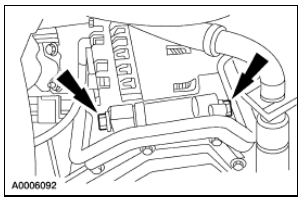


9. **NOTE:** The A/C suction line may need to be positioned rearward to ease generator removal.

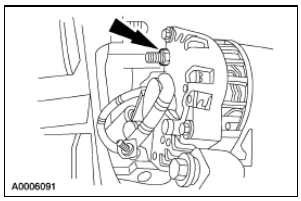
   Remove the top nut and through bolt.



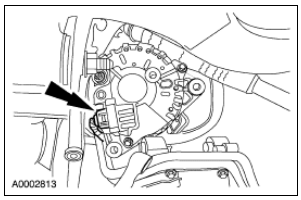
10. Remove the lower bolts.



11. Turn the generator slightly to access the generator positive cable nut and remove the nut.



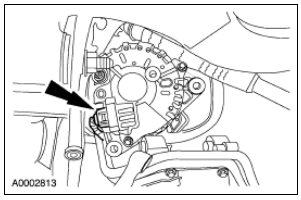
12. Lower the generator slightly and disconnect the electrical connector.



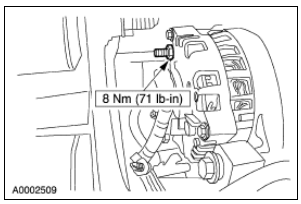
13. Remove the generator.
    - Rotate the generator to gain access for removal.
    - Remove the generator.

Installation

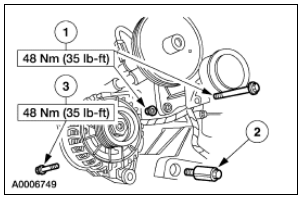
1. Position the generator and connect the electrical connector.



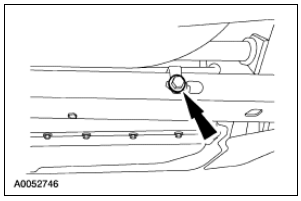
2. Rotate generator to gain access to the generator positive terminal and install cable and nut.



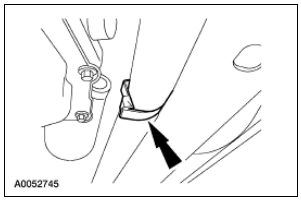
3. Install the generator and tighten in the sequence shown.
    1. Loosely assemble the pivot bolt and nut.
    2. Install the expanding bushing and bolt assembly in two stages.
        - Stage 1: Tighten the bolt to 20 Nm (15 lb-ft).
        - Stage 2: Tighten the bolt an additional 90 degrees.
    3. Install the bolt.



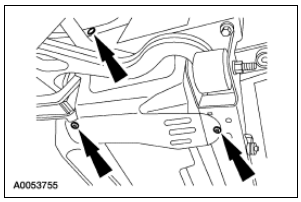
4. Install the LH A/C section line lower bracket and bolt.



5. Install the A/C suction line clip into the radiator core support.



6. Install the lower RH splash shield.



7. Install the front lower splash shield.
8. Lower the vehicle. For additional information, refer to Section 100-02 .
9. Install the accessory drive belt. For additional information, refer to Section 303-05 .
10. Install the air intake tube. For additional information, refer to Section 303-12 .
11. Connect the battery cable ground cable. For additional information, refer to Section 414-01 .

2002 Lincoln LS Contents/Index

-- F --

Fan - Pump, 3.0L

Fan - Pump, 3.9L

Fender

Fill Procedure

Fittings - R-Clip

Fittings - Vapor Tube

Flexplate

IN-VEH REP: Engine - 3.0L (4V)

IN-VEH REP: Engine - 3.9L

Floor Console Register

Fluid Pan, Gasket and Filter

Fluid Pump

Fluorescent Dye Leak Detection

Flywheel

IN-VEH REP: Engine - 3.0L (4V)

REM & INST: Clutch

Fog Lamps

Footwell Duct - Floor Console

Footwell Duct

Forward Clutch - Bonded Piston

Fresh Air Inlet Duct

Front Disc Brake

DESC & OPER: Front Disc Brake

DIAG & TEST: Front Disc Brake

Section Table of Contents

Front End Body Panels

DESC & OPER: Front End Body Panels

Section Table of Contents

Front Seat Backrest

DISASSEM & ASSEM: Seating

REM & INST: Seating

Front Seat Cushion

Front Seat

Front Suspension

DESC & OPER: Front Suspension

DIAG & TEST: Front Suspension

Section Table of Contents

Front Toe Adjustment

Front Wheel Speed Sensor

REM & INST: Anti-Lock Control Traction Control and Stability Assist

REM & INST: Anti-Lock Control Traction Control

REM & INST: Anti-Lock Control

Fuel Charging and Controls 3.0L (4V), Section Table of Contents

Fuel Charging and Controls 3.9L, Section Table of Contents

Fuel Charging And Controls

DESC & OPER: Fuel Charging and Controls 3.0L (4V)

DESC & OPER: Fuel Charging and Controls 3.9L

DIAG & TEST: Fuel Charging and Controls 3.0L (4V)

DIAG & TEST: Fuel Charging and Controls 3.9L

Fuel Filter

Fuel Injection Supply Manifold

Fuel Injectors

Fuel Pressure Relief Valve

Fuel Pressure Sensor - 3.0L

Fuel Pressure Sensor - 3.9L

Fuel Pump Module

Fuel System - General Information, Section Table of Contents

Fuel System

DESC & OPER: Fuel System - General Information

DIAG & TEST: Fuel System - General Information

Fuel Tank And Lines

DESC & OPER: Fuel Tank and Lines

DIAG & TEST: Fuel Tank and Lines

Fuel Tank and Lines, Section Table of Contents

Fuel Tank Filler Pipe

Fuel Tank Support Straps

Fuel Tank

Fuel Temperature Sensor - 3.0L

Fuel Transfer Pump

Fuel Vapor Control Tube Assembly Valve

Audio System

Refer to Wiring Diagrams Cell 130 , Entertainment System--General Information for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Inspection and Verification

1. **NOTE:** The audio unit is also referred to as the audio control module.

   Verify the customer concern by operating the electronic audio system with the engine running and the vehicle in motion.

2. Visually inspect for obvious signs of mechanical and electrical damage.

   Visual Inspection Chart

Mechanical	Electrical
• Audio unit • Digital audio compact disc player • Antenna or antenna cable • Antenna isolator module • Audio speakers, mounting/speaker cones • Radio ignition interference capacitors, radio frequency interference suppression bond, and radio receiver hood bonding strap	• Central junction box (CJB) fuse: ♦ 2 (5A) ♦ 27 (10A) • Rear battery junction box (Rear BJB) fuse: ♦ 14 (5A) ♦ 18 (20A) ♦ 25 (40A) ♦ 22 (20A) • Ignition switch • Circuitry

3. If the fault is not visually evident, proceed to speaker walk-around test, audio unit self-diagnostic mode (A100i and CDX6 only) and the diagnostic tool.

Audio Unit Self-Diagnostic Mode

NOTE: To enter the speaker walk-around test or the audio unit self-diagnostic mode, must be ON and in radio tuner mode (AM/FM). The audio unit self-diagnostic mode can only be entered while in the speaker walk-around test.

4. To enter the speaker walk-around test, simultaneously press the audio unit preset buttons 3 and 6.

5. The speaker walk-around test stops at each speaker and applies a different tone to each speaker for about 1-2 seconds. Each speaker is tested and displayed on the audio unit in the following sequence: RF, LF, LR, RR, Subwoofer I, Subwoofer II except for Premium CDX6 no Subwoofer I, Subwoofer II will display.

6. The speaker walk-around test automatically continues and tests:

- for speaker short. If a short is present, SPKR SHORT will be displayed.
- for CD/DJ. The audio unit display will show NO DJ if not present.

The speaker walk-around test will end and the audio unit will return to its previous setting.

To enter the following audio unit self-diagnostic modes, press the preset button desired while in the speaker walk-around test. This will abort the speaker walk-around test and start the selected test.

7. The audio unit self-diagnostic mode has five tests available:

- Preset button 1 = Audio internal/external SELF TEST. If SELF FAIL is displayed, press TUNE > to scroll view the DTCs stored. Refer to the audio unit Diagnostic Trouble Code (DTC) Index. If the system is OK, SELF PASS is displayed.
- Preset button 2 = View/Clear continuous diagnostic trouble codes (DTCs). NO DTCs is displayed if no DTCs are retrieved. If DTCs FOUND is displayed, press TUNE > button to view the DTCs retrieved. Refer to the audio unit Diagnostic Trouble Code (DTC) Index. To clear all DTCs press the EJECT button. DTCs CLEAR will be displayed.
- Preset button 3 = SIGNAL TEST. This test measures the average strength at the current tuner setting.
- Preset button 4 = Software configuration level. This test queries each audio system controller for its software configuration level. SOFT LEVELS will be displayed upon completion of the query. Press TUNE > to scroll view the software configuration version level.

Controller	Description	Audio Unit Display Example
Main	Main Micro Software Version	MAIN ##.##.##
CDSP	CDSP Micro Software Version	CDSP ##.##.##
ADSP	ADSP Micro Software Version	ADSP ##.##.##
Auxiliary	Auxiliary Software Version	AUX ##.##.##
CD/DJ	CDDJ Software Version	DJ ##.##.##
CD Changer	CDR Software Version	CD ##.##.##
Tape Deck	Tape Deck Software Version	TAP ##.##.##
RSC	Rear Seat Controller Software Version	RCP ##.##.##

- Preset button 5 = DISPLAY TEST. This test will light all the audio unit display segments for five seconds and then turn all segments off. When the test is complete, DISPLAY TEST is displayed on the bezel.

- Preset button 6 = CONFIG LEVELS. This will show the software configuration for the audio unit.

8. To exit audio unit self-diagnostic mode, turn the ignition switch or the audio unit OFF.

9. If the concern remains and the fault is not detected, proceed to Diagnostic Tool.

Diagnostic Tool

1. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:

- check that the program card is correctly installed.
- check the connections to the vehicle.
- check the ignition switch position.

2. **NOTE:** The audio unit must be in AM, FM1 or FM2 mode to enter diagnostic tool tester diagnostics.

   If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

3. Carry out the DATA LINK DIAGNOSTICS TEST. If the diagnostic tool responds with:

- CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
- NO RESP/NOT EQUIP for audio unit, go to Pinpoint Test A.
- SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the audio unit.

4. If the DTCs retrieved are related to the concern, go to the audio unit Diagnostic Trouble Code (DTC) Index to continue diagnostics.

5. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart to continue diagnostics.

Audio Unit Diagnostic Trouble Code (DTC) Index
NOTE: The audio unit and the diagnostic tool use the same diagnostic trouble codes.

DTC**Description****Source****Action**B1342ECU is DefectiveAudio UnitCLEAR and DOCUMENT the DTCs. CARRY OUT the audio unit On-Demand Self-Test. REMOVE the audio unit and SEND it to an authorized Ford Audio System repair facility if DTC B1342 is retrieved again. TEST the system for normal operation.B2401Audio Tape Deck Mechanism FaultAudio UnitVERIFY that no tape is inserted in the audio unit. CLEAR and DOCUMENT the DTCs. CARRY OUT the Audio Unit On-Demand self-test. If DTC B2401 is retrieved again, REMOVE the audio unit and SEND it to an authorized Ford Audio System repair facility.B2402Audio CD/DJ Thermal Shutdown FaultAudio UnitNot applicable for CDX6. Go To Pinpoint Test C .B2403Audio CD/DJ Internal FaultAudio UnitGo To Pinpoint Test C . Not applicable for CDX6.B2404Audio Steering Wheel Switch Circuit FaultAudio UnitGo To Pinpoint Test M .B2405Audio Single-Disc CD Player Thermal Shutdown FaultAudio UnitNot applicable.B2406Audio Single-Disc CD Player Internal FaultAudio UnitNot applicable.B2477Module Configuration FaultAudio UnitREFER to Section 418-01 .U2003Audio CD/D Jockey is Not RespondingAudio Unit

NOTE: U2003 is retrieved if CDDJ is not present, disconnected, or inoperative.

Go To Pinpoint Test C . Not applicable for CDX6.U2005Audio Rear Integrated Control Panel Unit is Not RespondingAudio Unit

NOTE: U2005 is retrieved if RICP is not present, disconnected, or inoperative.

Not applicable.U2008Audio Phone is Not RespondingAudio UnitREFER to Section 419-05 .U2014Audio Subwoofer Unit is Not RespondingAudio Unit

NOTE: U2014 is retrieved if subwoofer is not present, disconnected, or inoperative.

Go To Pinpoint Test L .U2020Center Image Amplifier is Not RespondingAudio Unit

NOTE: U2020 is retrieved if center image amplifier is not present, disconnected, or inoperative.

Go To Pinpoint Test I .

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE AUDIO UNIT

PINPOINT TEST B: THE AUDIO UNIT IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

PINPOINT TEST C: THE CD CHANGER IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

PINPOINT TEST D: THE AUDIO UNIT DOES NOT DISPLAY CD CHANGER INFORMATION

PINPOINT TEST E: POOR RECEPTION

PINPOINT TEST F: CONTINUOUS SEEK/SCAN IN AM/FM

PINPOINT TEST G: POOR QUALITY/DISTORTED SOUND FROM ONE OR MORE SPEAKERS (NOT ALL SPEAKERS)

PINPOINT TEST H: NO SOUND FROM ONE OR MORE SPEAKERS (NOT ALL SPEAKERS)

PINPOINT TEST I: NO SOUND FROM ONE OR MORE SPEAKERS (NOT ALL SPEAKERS) CENTER IMAGING

PINPOINT TEST J: NO SOUND FROM ALL SPEAKERS

PINPOINT TEST K: LOUD POPS WHEN CYCLING THE IGNITION SWITCH

PINPOINT TEST L: THE SUBWOOFER IS INOPERATIVE

PINPOINT TEST M: THE AUXILIARY AUDIO CONTROL IS INOPERATIVE/DOES NOT OPERATE CORRECTLY STEERING WHEEL CONTROL SWITCHES

Torque Specifications

Description	Nm	lb-in
Battery ground cable	10	89
CD changer bolts	5	44
CD changer nut	5	44
Center imaging amplifier nuts	5	44

Audio System

The audio system consists of the following:

- A100i audio unit
- CDX6 audio unit
- four premium speakers (audiophile)
- two subwoofer speakers (audiophile)
- subwoofer amplifier (located in the center underside of the package shelf)
- two center imaging speakers (audiophile)
- center imaging amplifier (audiophile) (located in the left side of instrument panel)
- CD changer (located in the glove compartment) (if equipped)
- antenna isolator module (located in the rear package tray)
- steering wheel controls

Audio System

Refer to Section 415-00 .

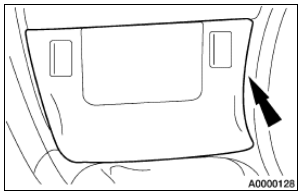
Audio Unit

Removal and Installation

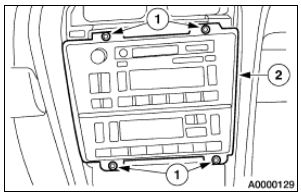
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Remove the center A/C register finish panel. For additional information, refer to Section 412-01 .

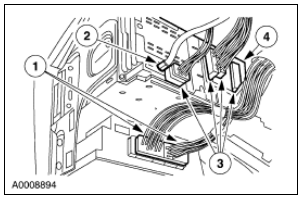
3. Remove the ashtray finish panel.
   - Disconnect the electrical connectors.



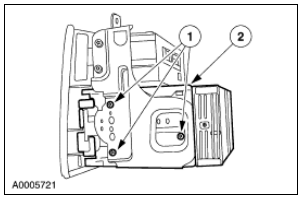
4. Position the audio/DATC assembly.
   1. Remove the bolts.
   2. Position the audio unit.



5. Remove the audio/DATC assembly.
   1. Disconnect the DATC electrical connectors.
   2. Disconnect the antenna lead-in cable.
   3. Disconnect the audio unit electrical connectors.
   4. Remove the audio unit.



6. Separate the audio unit from the audio/DATC assembly.
   1. Remove the six screws.
   2. Separate the audio unit.



7. To install, reverse the removal procedure.

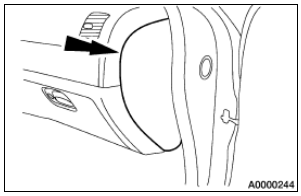
Compact Disc (CD) Changer

Removal and Installation

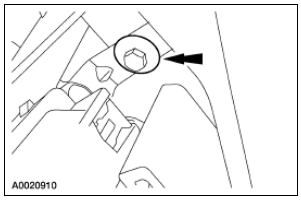
NOTE: Prior to the removal of the CD changer, it is necessary to remove the magazine.

1. Remove the glove compartment. For additional information, refer to Section 501-12 .

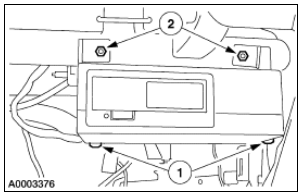
2. Remove the RH end panel.



3. Remove the CD changer bracket bolt.



4. Remove the CD changer.
    1. Remove the two bolts.
    2. Remove the nuts.
    - Disconnect the electrical connector.



5. Remove the brackets from the CD changer.

6. To install, reverse the removal procedure.

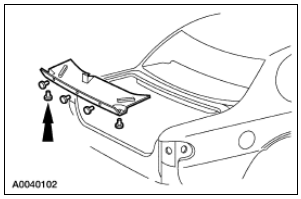
Subwoofer Amplifier

Removal and Installation

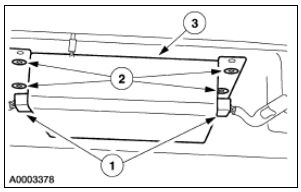
1. Disconnect the battery. For additional information, refer to Section 414-01 .

2. Open the luggage compartment lid.

3. Remove the luggage compartment front cover.
   - Remove the pin-type retainers.



4. Remove the subwoofer amplifier.
   1. Disconnect the electrical connectors.
   2. Remove the bolts.
   3. Remove the subwoofer amplifier.



5. To install, reverse the removal procedure.

Amplifier Center Imaging

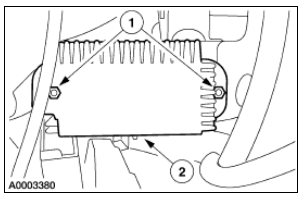
Removal and Installation

1. Disconnect the battery. For additional information, refer to Section 414-01 .

2. Remove the driver side instrument panel insulator.

3. Remove the driver side lower heat duct.

4. Remove the center imaging amplifier.
    1. Remove the nuts.
    2. Disconnect the electrical connector.



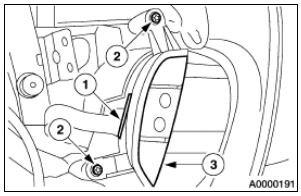
5. To install, reverse the removal procedure.

Auxiliary Control Steering Wheel Switch

Removal and Installation

1. Remove the driver side air bag module. For additional information, refer to Section 501-20B .

2. Remove the auxiliary control.
    1. Disconnect the electrical connector.
    2. Remove the screws.
    3. Remove the auxiliary control.



3. To install, reverse the removal procedure.

General Specifications

Item	Specification
Grid wire repair kit D8AZ-19562-AA	ESB-M4J58-A

Torque Specifications

Description	Nm	lb-in
Antenna isolator module bolts	9	80
Battery ground cable bolt	10	89

Antenna

The radio antenna is concealed on the inside of the rear window glass. The AM antenna consists of the rear window defroster grid and the FM antenna is the conductive tracing above the rear window defroster grid. The radio antenna uses an antenna isolator module mounted under the rear package tray trim panel to separate the AM signals, FM signals, and rear defroster power.

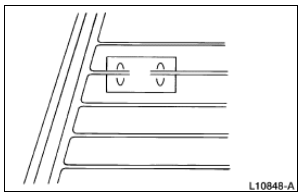
Antenna Grid Wire Repair

Special Tool(s)

 ST1171-A	Heat Gun or equivalent 107-R0300

NOTE: Any breaks longer than 25.4 mm (1 in) in one grid cannot be repaired. The back window glass must be replaced. Breaks equal to or shorter than 25.4 mm (1 in) in the heated back window grid wire can be successfully repaired by using the following procedure:

1. Obtain a grid wire repair repair kit meeting Ford specification ESB-M4J58-A.
2. The vehicle should be brought inside and allowed to reach 16°C (60°F) or above.
3. Clean the repair area with denatured alcohol.
4. Place the grid line mask over the break aligning the cut out slots on either side of the repair area.



5. Apply the epoxy to the repair area.
6. Remove the mask without disturbing the epoxy.
7. Use Heat Gun to heat the repair area for one to two minutes at a distance of about 25-50 mm (1-2 in). This procedure should heat the repair area to approximately 149°C (300°F).
8. The heated back window may be energized immediately after the repair. Optimum hardness and adhesion will occur after 24 hours. Do not disturb the repaired area until that time.

Antenna

Removal

1. The antenna is integral to the back window glass and can be repaired, but not replaced separately. For removal and installation of the back window glass, refer to Section 501-11 . For repair procedures, refer to Antenna Grid Wire Repair .

Cable

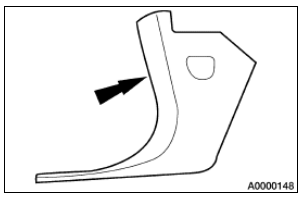
Removal and Installation

1. ⚠ **CAUTION: The antenna lead-in cable is not removable from the rear lamp wiring harness. If the cable needs to be replaced, leave it in the rear lamp wiring harness, install a new cable on top and secure it with ties.**

   Disconnect the battery ground cable. Refer to Section 414-01 .

2. Remove the instrument panel. Refer to Section 501-12 .

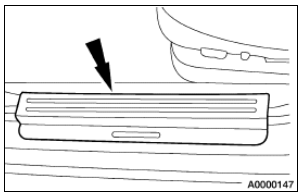
3. Remove the LH A-pillar lower trim panel.



4. **NOTE:** Front LH scuff plate shown. Rear LH scuff plate similar.

   Remove the front and rear LH scuff plates.

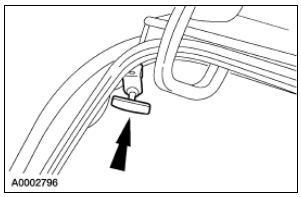
   - Remove the protective covers to expose the wiring harness.



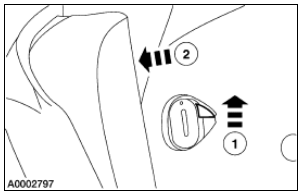
5. Remove the rear seat. For additional information, refer to Section 501-10

6. **NOTE:** The rear seat back release handles are located in the luggage compartment.

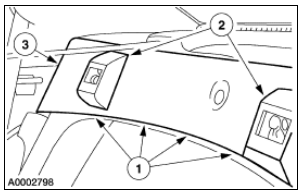
   Lower the LH and RH rear seat backrests.



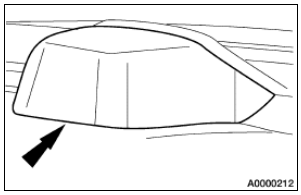
7. Position the LH and RH rear seat side bolsters aside.
   1. Release the upper retaining latches.
   2. Position the rear seat side bolsters aside.



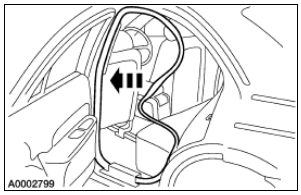
8. Remove the upper pass-through trim panel.
    1. Remove the five pin-type retainers.
    2. Release the latch covers.
    3. Remove the upper pass-through trim panel.



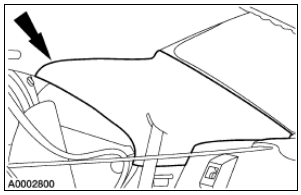
9. Remove the high mounted stoplamp cover.



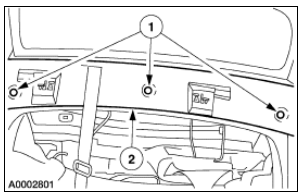
10. Position the LH and RH rear door opening sealing strips aside.



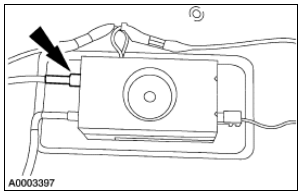
11. Position the LH and RH rear quarter panel trim panels aside.
    - Grasp trim panels at the top and gently pull outward to release the clips.



12. Remove the package tray.
    1. Remove the pin-type retainers.
    2. Remove the package tray.



13. Disconnect the antenna lead-in cable from the antenna isolator module.



14. ⚠ **CAUTION: The antenna lead-in cable is not removable from the rear lamp wiring harness. If the cable needs to be replaced, leave it in the rear lamp wiring harness, install a new cable on top and secure it with ties.**

    NOTE: To avoid noise after the new antenna lead-in cable has been installed, cut both ends of the old antenna lead-in cable to remove the metal connectors.

    To install, reverse the removal procedure.

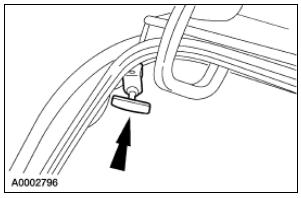
Module Isolator

Removal and Installation

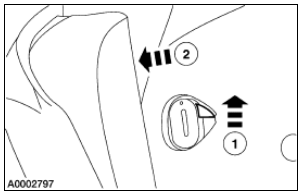
1. Disconnect the battery ground cable. Refer to Section 414-01 .

2. **NOTE:** The rear seat back release handles are located in the luggage compartment.

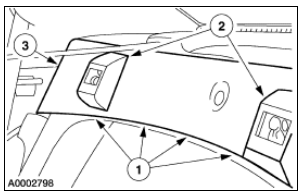
   Lower the LH and RH rear seat backrests.



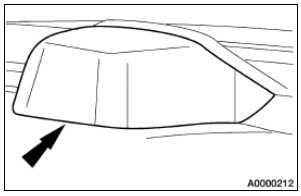
3. Position the LH and RH rear seat side bolsters aside.
   1. Release the upper retaining latches.
   2. Position the rear seat side bolsters aside.



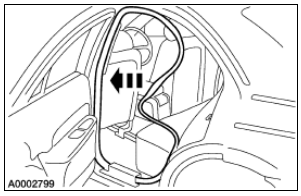
4. Remove the upper pass-through trim panel.
   1. Remove the five pin-type retainers.
   2. Release the latch covers.
   3. Remove the upper pass-through trim panel.



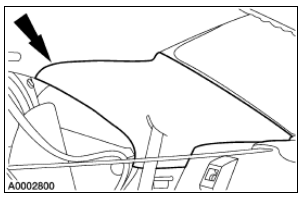
5. Remove the high mounted stoplamp cover.



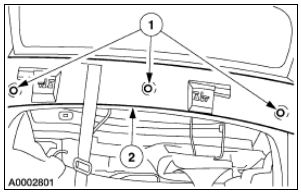
6. Position the LH and RH rear door opening sealing strips aside.



7. Position the LH and RH rear quarter panel trim panels aside.
   - Grasp trim panels at the top and gently pull outward to release the clips.



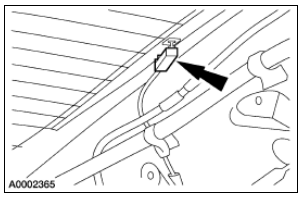
8. Remove the package tray.
   1. Remove the pin-type retainers.
   2. Remove the package tray.



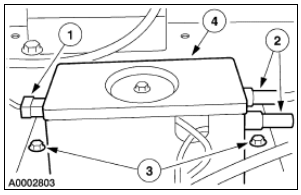
9. **NOTE:** RH rear defroster grid wiring harness shown, LH similar.

   Disconnect the LH and RH rear defroster grid wiring harness.

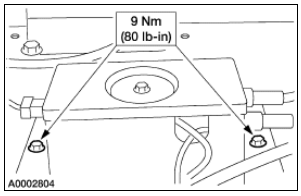
   - Release the harness retainers.



10. Remove the isolator module.
    1. Disconnect the electrical connector.
    2. Disconnect the antenna lead-in cables.
    3. Remove the bolts.
    4. Remove the isolator module.



11. To install, reverse the removal procedure.


9 Nm
(80 lb-in)
A0002804

Speakers

There are two speaker systems available:

- The premium sound speaker system.
- The optional audiophile speaker system.

The premium sound system has one speaker mounted in each door.

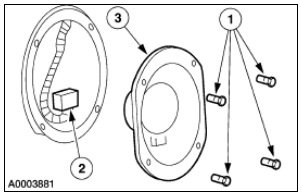
The optional audiophile system has one two-way speaker mounted in each door, two subwoofer speakers mounted to the package tray, and two center imaging speakers mounted in the center stack area of the instrument panel.

Speaker Door Mounted

Removal and Installation

1. Remove the door trim panel. Refer to Section 501-05 .

2. Remove the speakers.
    1. Remove the screws.
    2. Disconnect the electrical connector.
    3. Remove the speakers.



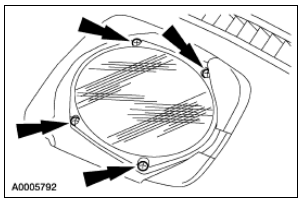
3. To install, reverse the removal procedure.

Subwoofer Speaker

Removal and Installation

1. Remove the package tray. Refer to Section 501-05 .

2. Remove the screws and the speaker.
   - Disconnect the electrical connector.



3. To install, reverse the removal procedure.

2002 Lincoln LS Contents/Index

-- G --

Geartrain

Generator and Regulator, Section Table of Contents

Generator - 3.0L

Generator - 3.9L

Generator

Glass - Roof Opening Assembly

Glass, Frames and Mechanisms

DESC & OPER: Glass, Frames and Mechanisms

DIAG & TEST: Glass, Frames and Mechanisms

Section Table of Contents

Global Positioning System (GPS) Antenna

Glove Compartment

2002 Lincoln LS Contents/Index

-- H --

Halfshaft Joint

Halfshaft

Handle - Exterior Front Door

Handle - Exterior Rear Door

Handle - Interior Door

Handles, Locks, Latches And Mechanisms

Handles, Locks, Latches and Mechanisms, Section Table of Contents

Headlamp Adjustment

Headlamps

Headliner

Heated Oxygen Sensor (HO2S) - 3.0L, 3.9L, Front

Heated Seat Module

Heated Seat Switch

Heater Core And Evaporator Core Housing

DISASSEM & ASSEM: Heating and Ventilation

REM & INST: Heating and Ventilation

Heater Core Backflushing

Heater Core

Heater Hose Coupling

Heater Hose - Assembly

Heating and Defrosting

Heating and Ventilation, Section Table of Contents

Height Adjuster - Front Shoulder Safety Belt

Height Adjustment

Horn - Switch

Horn

DESC & OPER: Horn

DIAG & TEST: Horn

REM & INST: Horn

Section Table of Contents

Hydraulic Brake Actuation

DESC & OPER: Hydraulic Brake Actuation

DIAG & TEST: Hydraulic Brake Actuation

Section Table of Contents

Hydraulic Control Unit (HCU)

REM & INST: Anti-Lock Control Traction Control and Stability Assist

REM & INST: Anti-Lock Control Traction Control

REM & INST: Anti-Lock Control

Hydraulic Cooling Fan System Filling and Bleeding

Hydraulic System

Hydraulic Tubes

Torque Specifications

Description	Nm	lb-ft	lb-in
Battery ground cable bolt	10		89
Fog lamp assembly nuts	5		44
Headlamp assembly bolts	6		53
Stoplamp assembly nuts	5		44

Exterior Lighting

The exterior lighting system consists of:

- headlamps
- autolamps
- parking lamps
- front marker lamps
- fog lamps
- rear lamps
- stoplamps
- high mounted stoplamp
- license plate lamps
- turn signals
- reversing lamps
- headlamp switch
- brake pedal position (BPP) switch

Headlamps

Refer to Wiring Diagrams Cell 85 , Exterior Lighting for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool
 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Principles of Operation

NOTE: The front electronic module (FEM), the rear electronic module (REM) and the instrument cluster module (ICM) must be reconfigured before installing a new module. Refer to Section 418-01 .

The vehicle electronic functions are divided into zones. The FEM controls the front portion of the vehicle and the REM controls the rear portion of the vehicle. These systems rely on the standard corporate protocol (SCP) communication network in order to transmit and receive signals. As a technician it is very important to understand:

- where the input (command) originates from.
- all information (messages) necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input (message) control the output of the feature, or does it output a message over the SCP communication network to another module.
- which module controls the output of the feature.

Exterior Lighting

The exterior lighting outputs are zone controlled by the FEM and REM. The front exterior lights are controlled by the FEM and the rear exterior lights are controlled by the REM. An additional function of the lighting system is a lamp outage function which indicates to the driver if certain exterior bulbs are not functioning. With a bulb inoperative, the FEM or REM will send a message to the instrument cluster and message center (if equipped with the message center), which will indicate to the driver that the lamp is inoperative with a lamp out indicator (with the message center a message will be displayed). To provide complete input and output functionality, each exterior lamp feature will be described individually. All exterior lighting is powered by the switched system power (SSP) feature (refer to Switched System Power [SSP]). A failure of all or any of the SSP features will cause inoperative exterior lighting. When diagnosing exterior lighting, it is essential to determine if all related symptoms and DTCs are controlled by the SSP feature.

Headlamps

The headlamps are controlled by the FEM and instrument cluster module. The headlamp and multifunction switches are hardwired to the instrument cluster. When the headlamp switch is in any position, the instrument

cluster module will send a command to the FEM through the SCP communication network. The FEM will process this information and output the appropriate command to the headlamps, which are hardwired to the FEM. This is the same for the low and high beams and flash-to-pass position. Daytime running lamps (DRL) is an additional feature which the FEM may be configured to include. Left and right low, as well as high beams will provide a lamp outage indication. Fault management of the headlamps will provide some headlamp functionality. In the event of all multifunction switch, all headlamp switch or ignition switch invalid or missing data failures, the low beams will be illuminated. There is also a headlamp battery saver feature. This feature turns off the headlamps in ten minutes after the ignition is turned off.

The vehicle electronic functions are divided into zones. The FEM controls the front portion of the vehicle and the REM controls the rear portion of the vehicle. These systems rely heavily on the SCP communication network in order to transmit and receive signals. As a technician it is very important to understand:

- where the input (command) originates from.
- all information (messages) necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input (message) control the output of the feature, or does it output a message over the SCP communication network to another module.
- which module controls the output of the feature.

Switched System Power (SSP)

The SSP is invoked by both the FEM and REM. This function removes power from relays that provide power to the exterior lamps, interior lamps, and power door locks. This is only accomplished when both the FEM and the REM are in sleep mode. The sleep function of the FEM and REM places the modules in sleep mode when the ignition switch is in the OFF position, and no wake up (input) signals occur for 30 minutes. The module will not sleep if the parking lamps or the hazard lamps are active. The following relays are controlled by the SSP function: SSP1, SSP2, SSP3, and SSP4. When either the FEM or REM are not in sleep mode, all SSP relays will be energized. When energized, each relay will supply power to multiple features/functions. For additional information, refer to the SSP Index for diagnosis and testing of SSP related issues.

Inspection and Verification

1. Verify the customer concern by operating the headlamps following these steps:
    1. Place the ignition switch in the ON position.
    2. Place the headlamp switch in the ON position.
    3. **NOTE:** For autolamps concerns, refer to Autolamps .

       Verify the low and high beam operation.
    4. Place the headlamps in the OFF position.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged FEM • Damaged instrument cluster	• Battery junction box (BJB) Fuses: ♦ 423 (30A)

	♦ 424 (30A) ♦ 427 (30A) ♦ 432 (30A) ♦ 425 (40A) ♦ 422 (20A) • Central junction box (CJB) Fuses: ♦ 204 (5A) ♦ 208 (5A) ♦ 209 (10A) ♦ 210 (5A) ♦ 211 (10A) ♦ 213 (5A) ♦ 217 (5A) ♦ 223 (10A) ♦ 225 (10A) ♦ 235 (5A) ♦ 205 (5A) ♦ 220 (10A) ♦ 207 (5A) • Damaged wiring harness • Loose or corroded connections • Damaged headlamp switch

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTIC TEST. If the diagnostic tool responds with:
   - CKT914, CKT915 or CKT70 =ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for FEM, go to Pinpoint Test A.
   - NO RESP/NOT EQUIP for REM, go to Pinpoint Test B.
   - NO RESP/NOT EQUIP for instrument cluster, go to Pinpoint Test C.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the FEM.

6. If the DTCs retrieved are related to the concern, go to FEM Diagnostic Trouble Code (DTC) Index, and Instrument Cluster Module (ICM) Diagnostic Trouble Code (DTC) Index, or SSP Relay Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

FEM Diagnostic Trouble Code (DTC) Index

FEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1319	Driver Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1327	Passenger Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1342	ECU Is Defective	FEM	CLEAR the DTCs. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new FEM. REFER to Section 419-10 .
B1438	Wiper Mode Select Switch Circuit Failure	FEM	REFER to Section 501-16 .
B1446	Wiper Park Sense Circuit Failure	FEM	REFER to Section 501-16 .
B1479	Wiper Washer Fluid Level Sensor Circuit Failure	FEM	REFER to Section 413-01 .
B1499	Lamp Turn Signal Left Circuit Failure	FEM	GO to Pinpoint Test AD .
B1501	Lamp Turn Signal Left Circuit Short to Battery	FEM	GO to Pinpoint Test AD .
B1503	Lamp Turn Signal Right Circuit Failure	FEM	GO to Pinpoint Test AD .
B1505	Lamp Turn Signal Right Circuit Short to Battery	FEM	GO to Pinpoint Test AD .
B1519	Hood Switch Circuit Failure	FEM	REFER to Section 419-01A .
B1567	Lamp Headlamp High-Beam Circuit Failure	FEM	GO to Pinpoint Test E .
B1676	Battery Pack Voltage Out of Range	FEM	REFER to Section 414-00 .
B1794	Lamp Headlamp Low-Beam Circuit Failure	FEM	GO to Pinpoint Test D .
B2214	Window Passenger Front Up Switch Short to Battery	FEM	REFER to Section 501-11 .
B2215	Window Passenger Front Down Switch Short to Battery	FEM	REFER to Section 501-11 .
B2312	Mirror Passenger Horizontal Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2316	Mirror Passenger Vertical Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2442	Intrusion Sensor Fault	FEM	REFER to Section 419-01A .
B2477	Module Configuration Failure	FEM	REFER to Section 418-01 .
C1284	Oil Pressure Switch Failure	FEM	REFER to Section 413-01 .
C1446	Brake Switch Circuit Failure	FEM	REFER to Section 413-01 .
C1924	VAPS Solenoid Actuator Output Circuit Short to Ground	FEM	REFER to Section 211-00 .
C1925	VAPS Solenoid Actuator Return Circuit Failure	FEM	REFER to Section 211-00 .
U1027	SCP (J1850) Invalid or Missing Data for Engine RPM	PCM	CARRY OUT the PCM self-test.
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS, ABS/TC, IVD	CARRY OUT the ABS, ABS/TC, or IVD self-test.
U1059		PCM	CARRY OUT the PCM self-test.

	SCP (J1850) Invalid or Missing Data for Transmission / Transaxle / PRNDL		
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the ICM self-test.
U1222	SCP (J1850) Invalid or Missing Data for Interior Lamps	ICM	CARRY OUT the ICM self-test.
U1227	SCP (J1850) Invalid or Missing Data for Body Status Request	ICM	CARRY OUT the ICM self-test.

REM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1201	Fuel Sender Circuit Failure	REM	REFER to Section 413-01 .
B1300	Power Door Lock Circuit Failure	REM	REFER to Section 501-14B .
B1310	Power Door Unlock Circuit Failure	REM	REFER to Section 501-14B .
B1331	Decklid Ajar Rear Door Circuit Failure	REM	REFER to Section 417-02 .
B1335	Door Ajar RR Circuit Failure	REM	REFER to Section 417-02 .
B1342	ECU Is Defective	REM	CLEAR and DOCUMENT the DTCs. CARRY OUT the instrument cluster self-test. INSTALL a new REM if DTC B1342 is retrieved again. REFER to Section 419-10 .
B1483	Brake Pedal Input Circuit Failure	REM	GO to Pinpoint Test P .
B1499	Lamp Turn Signal Left Circuit Failure	REM	GO to Pinpoint Test AA .
B1501	Lamp Turn Signal Left Circuit Short to Battery	REM	GO to Pinpoint Test AB .
B1503	Lamp Turn Signal Right Circuit Failure	REM	GO to Pinpoint Test Z .
B1505	Lamp Turn Signal Right Circuit Short to Battery	REM	GO to Pinpoint Test AC .
B1551	Decklid Release Circuit Failure	REM	REFER to Section 501-14B .
B1571	Door Ajar LR Circuit Failure	REM	REFER to Section 417-02 .
B1676	Battery Pack Voltage Out of Range	REM	REFER to Section 414-00 .
B2172	Inertia Switch Input Circuit Open	REM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
B2174	Window Driver Rear Remote Up Switch Short to Battery	REM	REFER to Section 501-16 .
B2178	Window Driver Rear Remote Down Switch Short to Battery	REM	REFER to Section 501-16 .
B2190	Window Passenger Rear Remote Up Switch Short to Battery	REM	REFER to Section 501-16 .
B2194	Window Passenger Rear Remote Down Switch Short to Battery	REM	REFER to Section 501-16 .

B2477	Module Configuration Failure	REM	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS,ABS/TC, or IVD	CARRY OUT the ABS, ABS/TC, or IVD self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/ PRNDL	PCM	CARRY OUT the PCM self-test.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the ICM self-test

Instrument Cluster Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1201	Fuel Sender Circuit Failure	ICM	REFER to Section 413-01 .
B1205	EIC Switch-1 Assembly Circuit Failure	ICM	INSTALL a new instrument cluster; REFER to Section 413-01 . TEST the system for normal operation.
B1209	EIC Switch-2 Assembly Circuit Failure	ICM	INSTALL a new instrument cluster; REFER to Section 413-01 . TEST the system for normal operation.
B1213	Anti-Theft Number of Programmed Keys Is Below Minimum	ICM	REFER to Section 419-01B .
B1246	Dim Panel Potentiometer Switch Circuit Failure	ICM	REFER to Section 413-00 .
B1342	ECU Is Defective	ICM	CLEAR and DOCUMENT the DTCs. CARRY OUT the instrument cluster Self-Test. INSTALL a new instrument cluster if DTC B1342 is retrieved again. REFER to Section 413-01 .
B1352	Ignition Key-In Circuit Failure	ICM	REFER to Section 211-05 .
B1470	Lamp Headlamp Input Circuit Failure	ICM	GO to Pinpoint Test D .
B1492	Ignition Cylinder Sensor Open Circuit	ICM	REFER to Section 419-01B .
B1567	Lamp Headlamp High-Beam Circuit Failure	ICM	GO to Pinpoint Test E .
B1600	PATS Ignition Key Transponder Signal Is Not Received	ICM	REFER to Section 419-01B .
B1601	PATS Received Incorrect Key-Code From Ignition Key Transponder	ICM	REFER to Section 419-01B .
B1602	PATS Received Invalid Format of Key-Code From Ignition Key Transponder	ICM	REFER to Section 419-01B .
B1676	Battery Pack Voltage Out of Range	ICM	GO to Pinpoint Test J .
B1681	PATS Transceiver Module Signal Is Not Received	ICM	REFER to Section 419-01B .
B1689	Autolamp Delay Circuit Failure	ICM	GO to Pinpoint Test N .
B1875	Turn Signal / Hazard Switch Signal Circuit Failure	ICM	GO to Pinpoint Test AE .
B2103	Antenna Not Connected	ICM	REFER to Section 419-01B .

B2139	Data Mismatch (Receive Data Does Not Match What Was Expected)	ICM	REFER to Section 419-01A .
B2141	NVM Configuration Failure	ICM	REFER to Section 419-01B .
B2143	NVM Memory Failure	ICM	REFER to Section 419-01B .
B2162	Data Mismatch #2 (receive data does not match what was expected)	ICM	REFER to Section 419-01B .
B2328	Column Reach Feedback Potentiometer Circuit Failure	ICM	REFER to Section 211-04 .
B2332	Column Tilt Feedback Potentiometer Circuit Failure	ICM	REFER to Section 211-04 .
B2351	Steering Column Switch Circuit Failure	ICM	REFER to Section 211-04 .
B2431	Transponder Programming Failed	ICM	REFER to Section 419-01A .
B2472	Fog Lamp Switch Failure	ICM	GO to Pinpoint Test AS .
B2477	Module Configuration Failure	ICM	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS/TC/IVD	CARRY OUT the ABS/TC/IVD self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/PRNDL	PCM	CARRY OUT the PCM self-test.
U1073	SCP (J1850) Invalid or Missing Data for Engine Coolant Fluid Temperature	PCM	CARRY OUT the PCM self-test.
U1123	SCP (J1850) Invalid or Missing Data for Odometer Rolling Count	ABS/TC/IVD	CARRY OUT the ABS/TC/IVD self-test.
U1131	SCP (J1850) Invalid or Missing Data for Fuel System	ICM	GO to Pinpoint Test D .
U1147	SCP (J1850) Invalid or Missing Data for Vehicle Security System	PCM	CARRY OUT the PCM self-test.

SSP Relay Index

Relay	Fuse	Controlled System(s)
SSP1	BJB Fuse 427 (30A)	• Driver power door lock (FEM) • LH/RH high beam headlamps (FEM) • RF park/turn/side marker lamps (FEM) • RH low beam headlamp • Driver power mirror
SSP2	BJB Fuse 432 (30A)	• LH low beam headlamp (FEM) • LF park/turn/side marker lamps (FEM) • Interior courtesy/ demand lighting • Windshield wiper washer pump • Switch illumination backlighting
SSP3	BJB Fuse 424 (30A)	• High mounted stoplamp (REM) • RR park/stoplamps (REM) • Reversing lamps (REM) • LR turn signal (REM) • Passenger power mirror

		• Trailer stoplamps/turn signals (if equipped with trailer tow)
SSP4	BJB Fuse 423 (30A)	• LR park/stoplamps (REM) • RR turn signal (REM) • Passenger door/side locks (REM) • License lamps • Luggage compartment lid release solenoid/switch • Fuel door release solenoid/switch • Luggage compartment lamp • Trailer park lamps (if equipped with trailer tow)

When diagnosing an SSP relay, check that all systems for that relay are inoperative. Refer to Symptom Chart if:

- all systems for one SSP relay are inoperative.
- all systems for all SSP relays are inoperative.

Symptom Chart

Symptom Chart
Pinpoint Tests

⚠ **CAUTION: Electronic modules are sensitive to electrical charges. If exposed to these charges, damage may result.**

PINPOINT TEST A: NO COMMUNICATION WITH THE FRONT ELECTRONIC MODULE

PINPOINT TEST B: NO COMMUNICATION WITH THE REAR ELECTRONIC MODULE

PINPOINT TEST C: NO COMMUNICATION WITH THE INSTRUMENT CLUSTER MODULE

PINPOINT TEST D: ONE LOW BEAM HEADLAMP IS INOPERATIVE

PINPOINT TEST E: ONE HIGH BEAM HEADLAMP IS INOPERATIVE

PINPOINT TEST F: EXTERIOR LAMPS ARE INOPERATIVE RF PARK, RF TURN, RF SIDE MARKER LAMPS, RF LOW BEAM, LF HIGH BEAM, LF PARK, LF TURN, AND LF SIDE MARKER

PINPOINT TEST G: THE HEADLAMPS ARE ON CONTINUOUSLY BOTH LOW BEAMS

PINPOINT TEST H: THE HEADLAMPS ARE ON CONTINUOUSLY SINGLE LOW/HIGH BEAMS

PINPOINT TEST I: THE POWER SUPPLY RELAY IS INOPERATIVE ALL SSP FEATURES

PINPOINT TEST J: THE POWER SUPPLY RELAY IS INOPERATIVE SSP1

PINPOINT TEST K: THE POWER SUPPLY RELAY IS INOPERATIVE SSP2

PINPOINT TEST L: THE POWER SUPPLY RELAY IS INOPERATIVE SSP3

PINPOINT TEST M: THE POWER SUPPLY RELAY IS INOPERATIVE SSP4

Autolamps

Refer to Wiring Diagrams Cell 87 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool
 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Principles of Operation

NOTE: The front electronic module (FEM), the rear electronic module (REM) and the instrument cluster module (ICM) must be reconfigured before installing a new module. Refer to Section 418-01 .

The vehicle's electronic functions are divided into zones. The FEM controls the front portion of the vehicle and the REM controls the rear portion of the vehicle. These systems rely heavily on the standard corporate protocol (SCP) communication network in order to transmit and receive signals. As a technician it is very important to understand:

- where the input (command) originates from.
- all information (messages) necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input (message) control the output of the feature, or does it output a message over the SCP communication network to another module.
- which module controls the output of the feature.

Exterior lighting

The exterior lighting outputs are zone controlled by the front electronic module (FEM) and rear electronic module (REM). The FEM and REM. An additional function of the lighting system is a lamp outage function which indicates to the driver if certain exterior bulbs are not functioning. With a bulb inoperative, the FEM or REM will send a message to the instrument cluster and message center (if equipped with the message center) which will in turn indicate to the driver that the lamp is inoperative with a lamp out indicator (with the message center a message will be displayed). To provide complete input and output functionality, each exterior lamp feature will be described individually. All exterior lighting is powered by the switched system power (SSP) feature (refer to Switched System Power [SSP]). A failure of all or any of the SSP features will cause inoperative exterior lighting. When diagnosing exterior lighting, it is essential to determine if all related symptoms and DTCs are controlled by the SSP feature.

Autolamps

The autolamps are controlled by the headlamp switch, autolamp sensor, instrument cluster module and the FEM. The headlamps may be in the high or low beam position depending on the multifunction switch

position. When the headlamp switch is in the autolamp position, the instrument cluster module will send an ON or OFF command to the FEM, depending on the signal from the autolamp sensor. The FEM will process this information and output the appropriate command to the headlamps, which are hardwired to the FEM. The autolamps will remain ON for approximately 20 seconds after the ignition switch is changed from the RUN position to the ACC or OFF position.

Autolamps and daytime running lamps (DRL) are two functions which the FEM may be configured to include.

Left and right low, as well as high beams will provide a lamp outage indication. Fault management of the headlamps will provide some headlamp functionality. In the event of all multifunction switch, all headlamp switch or ignition switch invalid or missing data failures, the low beams will be illuminated.

The vehicle's electronic functions are divided into zones. The FEM controls the front portion of the vehicle and the REM controls the rear portion of the vehicle. These systems rely heavily on the SCP communication network in order to transmit and receive signals. As a technician it is very important to understand:

- where the input (command) originates from.
- all information (messages) necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input (message), control the output of the feature, or does it output a message over the SCP communication network to another module.
- which module controls the output of the feature.

Switched System Power (SSP)

The SSP is invoked by both the FEM and REM. This function removes power from relays that provide power to the exterior lamps, interior lamps, and power door locks. This is only accomplished when both the FEM and the REM are in sleep mode. The sleep function of the FEM and REM places the modules in sleep mode when the ignition switch is in the OFF position, and no wake up (input) signals occur for 30 minutes. The module will not sleep if the parking lamps or the hazard lamps are active. The following relays are controlled by the SSP function: SSP1, SSP2, SSP3, and SSP4. When either the FEM or REM are not in sleep mode, all SSP relays will be energized. When energized, each relay will supply power to multiple features/functions. For additional information, go to the SSP Index for diagnosis and testing of SSP related issues. Refer to Headlamps .

Inspection and Verification

1. Verify the customer concern by operating the autolamps following these steps:
    1. Place the ignition switch (11572) in the ON position.
    2. Place the headlamp switch (11654) in the ON position.
    3. **NOTE:** For headlamp concerns, refer to Headlamps .

       Verify the low beam operation.
    4. Place the headlamps in the autolamp position.
    5. **NOTE:** When aiming light and covering the light sensor amplifier, there may be a one minute delay for the autolamps to change conditions.

       Verify the autolamp operation by aiming a light at the light sensor amplifier and removing the light source and covering the light sensor amplifier. The headlamps should turn OFF with the light and illuminate with the light sensor amplifier covered.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged FEM • Damaged instrument cluster (10849)	• Battery junction box (BJB) Fuses: ♦ 427 (30A) ♦ 432 (30A) ♦ 422 (20A) ♦ 423 (30A) ♦ 424 (30A) ♦ 425 (40A) • Central junction box (CJB) Fuses: ♦ 204 (5A) ♦ 205 (5A) ♦ 213 (5A) ♦ 220 (5A) • Damaged wiring harness • Loose or corroded connections • Damaged headlamp switch

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTIC TEST. If the diagnostic tool responds with:
   - CKT 914, CKT 915 or CKT 70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for FEM, go to Pinpoint Test A.
   - NO RESP/NOT EQUIP for instrument cluster, go to Pinpoint Test C.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the FEM.

6. If the DTCs retrieved are related to the concern, go to FEM Diagnostic Trouble Code (DTC) Index, REM Diagnostic Trouble Code (DTC) Index, Instrument Cluster Diagnostic Trouble Code (DTC) Index, or SSP Relay Index to continue diagnostics. Refer to Headlamps .

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST N: THE AUTOLAMPS ARE INOPERATIVE

PINPOINT TEST O: THE AUTO LAMPS ARE ON CONTINUOUSLY

Stoplamps

Refer to Wiring Diagrams Cell 90 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool
 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Principles of Operation

NOTE: The front electronic module (FEM), the rear electronic module (REM) and the instrument cluster module (ICM) must be reconfigured before installing a new module. Refer to Section 418-01 .

The vehicle's electronic functions are divided into zones. The FEM controls the front portion of the vehicle and the REM controls the rear portion of the vehicle. These systems rely heavily on the standard corporate protocol (SCP) communication network in order to transmit and receive signals. As a technician it is very important to understand:

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- does the module which received the input (message), control the output of the feature, or does it output a message over the SCP communication network to another module.
- which module controls the output of the feature.

Exterior Lighting

The exterior lighting outputs are zone controlled by the FEM and REM. The front exterior lights are controlled by the FEM and the rear exterior lights are controlled by the REM. An additional function of the lighting system is a lamp outage function which indicates to the driver if certain exterior bulbs are not functioning. With a bulb inoperative, the FEM or REM will send a message to the instrument cluster and message center (if equipped with the message center) which will in turn indicate to the driver that the lamp is inoperative with a lamp out indicator (with the message center a message will be displayed). To provide complete input and output functionality, each exterior lamp feature will be described individually. All exterior lighting is powered by the switched system power (SSP) feature (refer to Switched System Power [SSP]). A failure of all or any of the SSP features will cause inoperative exterior lighting. When diagnosing exterior lighting, it is essential to determine if all related symptoms and DTCs are controlled by the SSP feature.

Stoplamps

Brake lighting is controlled by the REM. The brake pedal position (BPP) switch is hardwired to the REM. When the brake pedal is depressed, the BPP switch will input information to the REM. Then, the REM will

process the information and output to the left, right, and high mounted stoplamps. Only the left and right stoplamps will provide lamp outage indication.

The vehicle's electronic functions are divided into zones. The FEM controls the front portion of the vehicle and the REM controls the rear portion of the vehicle. These systems rely heavily on the SCP communication network in order to transmit and receive signals. As a technician it is very important to understand:

- where the input (command) originates from.
- all information (messages) necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input (message), control the output of the feature, or does it output a message over the SCP communication network to another module.
- which module controls the output of the feature.

Switched System Power (SSP)

The SSP is invoked by both the FEM and REM. This function removes power from relays that provide power to the exterior lamps, interior lamps, and power door locks. This is only accomplished when both the FEM and the REM are in sleep mode. The sleep function of the FEM and REM places the modules in sleep mode when the ignition switch is in the OFF position, and no wake up (input) signals occur for 30 minutes. The module will not sleep if the parking lamps or the hazard lamps are active. The following relays are controlled by the SSP function: SSP1, SSP2, SSP3, and SSP4. When either the FEM or REM are not in sleep mode, all SSP relays will be energized. When energized, each relay will supply power to multiple features/functions. For additional information, go to the SSP Index for diagnosis and testing of SSP related issues. Refer to Headlamps

Inspection and Verification

1. Verify the customer concern by operating the stoplamps.

2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged REM	• Battery junction box (BJB) Fuses: ♦ 403 (5A) ♦ 407 (5A) ♦ 423 (30A) ♦ 424 (30A) ♦ 430 (30A) ♦ 431 (30A) • Central junction box (CJB) Fuses: ♦ 204 (5A) ♦ 220 (10A) ♦ 235 (5A) • Damaged wiring harness

	• Loose or corroded connections • Damaged BPP switch

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTIC TEST. If the diagnostic tool responds with:
   - CKT914, CKT915 or CKT70 =ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for REM, go to Pinpoint Test B.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the FEM.

6. If the DTCs retrieved are related to the concern, go to FEM Diagnostic Trouble Code (DTC) Index, and Instrument Cluster Diagnostic Trouble Code (DTC) Index, or SSP Relay Index to continue diagnostics. Refer to Headlamps .

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

Symptom Chart

Symptom Chart
Pinpoint Tests

PINPOINT TEST P: THE STOPLAMPS ARE INOPERATIVE

PINPOINT TEST Q: ONE OR MORE STOPLAMPS ARE INOPERATIVE RR STOPLAMP

PINPOINT TEST R: ONE OR MORE STOPLAMPS ARE INOPERATIVE LR STOPLAMP

PINPOINT TEST S: ONE OR MORE STOPLAMPS ARE INOPERATIVE HIGH MOUNTED STOPLAMP

PINPOINT TEST T: THE EXTERIOR LAMP(S) ARE INOPERATIVE LR STOP AND PARK LAMPS

PINPOINT TEST U: THE EXTERIOR LAMP(S) ARE INOPERATIVE RR STOP AND PARK LAMPS

PINPOINT TEST V: THE STOPLAMPS ARE ON CONTINUOUSLY ALL STOPLAMPS

PINPOINT TEST W: THE STOPLAMPS ARE ON CONTINUOUSLY RR STOPLAMP ONLY

PINPOINT TEST X: THE STOPLAMPS ARE ON CONTINUOUSLY LR STOPLAMP ONLY

PINPOINT TEST Y: THE STOPLAMPS ARE ON CONTINUOUSLY HIGH MOUNTED STOPLAMP ONLY

Turn Signal and Hazard Lamps

Refer to Wiring Diagrams Cell 90 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool
 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Principles of Operation

NOTE: The front electronic module (FEM), the rear electronic module (REM), and the instrument cluster module (ICM) must all be reconfigured before installing a new module. Refer to Section 418-01 .

The vehicle electronic functions are divided into zones. The FEM controls the front portion of the vehicle and the REM controls the rear portion of the vehicle. These systems rely heavily on the standard corporate protocol (SCP) communication network in order to transmit and receive signals. As a technician it is very important to understand:

- where the input (command) originates from.
- all information (messages) necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input (message), control the output of the feature, or does it output a message over the SCP communication network to another module.
- which module controls the output of the feature.

Exterior Lighting

The exterior lighting outputs are zone controlled by the FEM and REM. The front exterior lights are controlled by the FEM and the rear exterior lights are controlled by the REM. An additional function of the lighting system is a lamp outage function which indicates to the driver if certain exterior bulbs are not functioning. With a bulb inoperative, the FEM or REM will send a message to the instrument cluster and message center (if equipped with the message center) which will in turn indicate to the driver that the lamp is inoperative with a lamp out indicator (with the message center a message will be displayed). To provide complete input and output functionality, each exterior lamp feature will be described individually. All exterior lighting is powered by the switched system power (SSP) feature (refer to Switched System Power [SSP]). A failure of all or any of the SSP features will cause inoperative exterior lighting. When diagnosing exterior lighting, it is essential to determine if all related symptoms and DTCs are controlled by the SSP feature.

Turn Signal, Cornering and Hazard Lamps

The LF and RF turn signal, LR and RR turn signal outputs, front and rear hazard lamp outputs, and the cornering lamp outputs are controlled by the FEM and REM. The multifunction switch and the hazard switch

are hardwired to the instrument cluster. When the switch is in the left or right turn position, or the hazard switch is placed in the ON position, the instrument cluster will send a command through the standard corporate protocol (SCP) network to the FEM and REM, which will process this information and output the appropriate command to the front and rear turn, and hazard lamps. When the instrument cluster commands a turn signal ON, the FEM and REM additionally command the appropriate cornering lamp, which is hard-wired to the FEM. All turn lamps will provide lamp outage indication.

The vehicle's electronic functions are divided into zones. The FEM controls the front portion of the vehicle and the REM controls the rear portion of the vehicle. These systems rely heavily on the SCP communication network in order to transmit and receive signals. As a technician it is very important to understand:

- where the input (command) originates from.
- all information (messages) necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input (message), control the output of the feature, or does it output a message over the SCP communication network to another module.
- which module controls the output of the feature.

Switched System Power (SSP)

The SSP is invoked by both the FEM and REM. This function removes power from relays that provide power to the exterior lamps, interior lamps, and power door locks. This is only accomplished when both the FEM and the REM are in sleep mode. The sleep function of the FEM and REM places the modules in sleep mode when the ignition switch is in the OFF position, and no wake up (input) signals occur for 30 minutes. The module will not sleep if the parking lamps or the hazard lamps are active. The following relays are controlled by the SSP function: SSP1, SSP2, SSP3, and SSP4. When either the FEM or REM are not in sleep mode, all SSP relays will be energized. When energized, each relay will supply power to multiple features/functions. For additional information, go to the SSP Index for diagnosis and testing of SSP related issues. Refer to Headlamps .

Inspection and Verification

1. Verify the customer concern by operating the turn signal, and hazard lamps.

2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged FEM • Damaged REM • Damaged instrument cluster • Damaged multifunction switch	• Battery junction box (BJB) fuses: ♦ 402 (10A) ♦ 406 (10A) ♦ 412 (5A) ♦ 422 (20A) ♦ 423 (30A) ♦ 424 (30A) ♦ 425 (40A) ♦ 427 (30A)

	♦ 432 (30A) • Central junction box (CJB) fuses: ♦ 208 (5A) ♦ 210 (5A) ♦ 213 (5A) ♦ 220 (5A) • Damaged wiring harness • Loose or corroded connections • Damaged bulbs

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTIC TEST. If the diagnostic tool responds with:
   - CKT914, CKT915 or CKT70 =ALL ECUS NO RESP/NOT EQUIP, REFER to Section 418-00 .
   - NO RESP/NOT EQUIP for FEM, go to Pinpoint Test A.
   - NO RESP/NOT EQUIP for REM, go to Pinpoint Test B.
   - NO RESP/NOT EQUIP for instrument cluster, go to Pinpoint Test C.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the FEM.

6. If the DTCs retrieved are related to the concern, go to FEM Diagnostic Trouble Code (DTC) Index, REM Diagnostic Trouble Code (DTC) Index, Instrument Cluster Diagnostic Trouble Code (DTC) Index, or SSP Relay Index to continue diagnostics. Refer to Headlamps .

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST Z: ONE TURN SIGNAL LAMP IS NEVER ON RR TURN LAMP

PINPOINT TEST AA: ONE TURN SIGNAL LAMP IS NEVER ON LR TURN LAMP

PINPOINT TEST AB: ONE TURN SIGNAL LAMP IS ALWAYS ON LR TURN LAMP

PINPOINT TEST AC: ONE TURN SIGNAL LAMP IS ALWAYS ON RR TURN LAMP

PINPOINT TEST AD: ONE TURN SIGNAL/HAZARD LAMP IS NEVER/ALWAYS ON FRONT

PINPOINT TEST AE: THE HAZARD FLASHER LAMPS ARE NEVER/ALWAYS ON

Parking, Rear and License Lamps

Refer to Wiring Diagrams Cell 92 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool
 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Principles of Operation

NOTE: The front electronic module (FEM), the rear electronic module (REM), and the instrument cluster module (ICM) must be reconfigured before installing a new module. Refer to Section 418-01 .

The vehicle electronic functions are divided into zones. The FEM controls the front portion of the vehicle and the REM controls the rear portion of the vehicle. These systems rely heavily on the standard corporate protocol (SCP) communication network in order to transmit and receive signals. As a technician it is very important to understand:

- where the input (command) originates from.
- all information (messages) necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input (message), control the output of the feature, or does it output a message over the SCP communication network to another module.
- which module controls the output of the feature.

Exterior Lighting

The exterior lighting outputs are zone controlled by the FEM and REM. The front exterior lights are controlled by the FEM and the rear exterior lights are controlled by the REM. An additional function of the lighting system is a lamp outage function which indicates to the driver if certain exterior bulbs are not functioning. With a bulb inoperative, the FEM or REM will send a message to the instrument cluster and message center (if equipped with the message center), which will indicate to the driver that the lamp is inoperative with a lamp out indicator (with the message center a message will be displayed). To provide complete input and output functionality, each exterior lamp feature will be described individually. All exterior lighting is powered by the switched system power (SSP) feature (refer to Switched System Power [SSP]). A failure of all or any of the SSP features will cause inoperative exterior lighting. When diagnosing exterior lighting, it is essential to determine if all related symptoms and DTCs are controlled by the SSP feature.

Parking, Rear or License Lamps

For the LH and RH rear park, license, and LH and RH front park lamps, outputs are controlled by the REM and FEM. The headlamp switch is hardwired to the ICM. When the switch is in the headlamp or park

position, the ICM will send a command via the network link to the FEM and REM. The REM and FEM will process this information and output the appropriate command to the rear park, license, and front park lamps, which are hardwired to the REM and FEM. Only the left and right rear lamps will provide lamp outage indication. Fault management of the park lamps will provide rear park lamp functionality in the event of certain multifunction switch, headlamp switch, ignition switch, REM or FEM failures. The park lamps are also part of the daytime running lamps (DRL) feature.

The vehicle's electronic functions are divided into zones. The FEM controls the front portion of the vehicle and the REM controls the rear portion of the vehicle. These systems rely heavily on the SCP communication network in order to transmit and receive signals. As a technician it is very important to understand:

- where the input (command) originates from.
- all information (messages) necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input (message), control the output of the feature, or does it output a message over the SCP communication network to another module.
- which module controls the output of the feature.

Switched System Power (SSP)

The SSP is invoked by both the FEM and REM. This function removes power from relays that provide power to the exterior lamps, interior lamps, and power door locks. This is only accomplished when both the FEM and the REM are in sleep mode. The sleep function of the FEM and REM places the modules in sleep mode when the ignition switch is in the OFF position, and no wake up (input) signals occur for 30 minutes. The module will not sleep if the parking lamps or the hazard lamps are active. The following relays are controlled by the SSP function: SSP1, SSP2, SSP3, and SSP4. When either the FEM or REM are not in sleep mode, all SSP relays will be energized. When energized, each relay will supply power to multiple features/functions. For additional information, go to the SSP Index for diagnosis and testing of SSP related issues. Refer to Headlamps .

Inspection and Verification

1. Verify the customer concern by operating the turn signal, cornering and hazard lamps.

2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged FEM • Damaged REM • Damaged instrument cluster	• Battery junction box (BJB) Fuses: ♦ 402 (10A) ♦ 403 (5A) ♦ 407 (5A) ♦ 412 (5A) ♦ 423 (30A) ♦ 424 (30A) ♦ 425 (40A) ♦ 427 (30A)

	♦ 432 (30A) • Central junction box (CJB) Fuses: ♦ 204 (5A) ♦ 208 (5A) ♦ 210 (5A) ♦ 213 (5A) ♦ 220 (10A) • Damaged wiring harness • Loose or corroded connections • Damaged bulbs

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTIC TEST. If the diagnostic tool responds with:
   - CKT914, CKT915 or CKT70 =ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for FEM, go to Pinpoint Test A.
   - NO RESP/NOT EQUIP for REM, go to Pinpoint Test B.
   - NO RESP/NOT EQUIP for instrument cluster, go to Pinpoint Test C.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the REM .

6. If the DTCs retrieved are related to the concern, go to the FEM Diagnostic Trouble Code (DTC) Index, REM Diagnostic Trouble Code (DTC) Index, Instrument Cluster Diagnostic Trouble Code (DTC) Index, or SSP Relay Index to continue diagnostics. Refer to Headlamps .

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

Symptom Chart

Symptom Chart
Pinpoint Tests

PINPOINT TEST AF: ONE OR MORE PARKING, REAR, OR LICENSE LAMP IS INOPERATIVE FRONT PARKING AND MARKER LAMPS

PINPOINT TEST AG: ONE OR MORE PARKING, REAR OR LICENSE LAMPS ARE INOPERATIVE LEFT REAR LAMPS

PINPOINT TEST AH: ONE OR MORE PARKING, REAR OR LICENSE LAMP IS INOPERATIVE RIGHT REAR LAMP

PINPOINT TEST AI: ONE OR MORE PARKING, REAR OR LICENSE LAMP IS INOPERATIVE LICENSE LAMPS

PINPOINT TEST AJ: THE EXTERIOR LAMP(S) ARE INOPERATIVE LF OR RF PARKING AND TURN LAMPS

PINPOINT TEST AK: THE EXTERIOR LAMP(S) ARE INOPERATIVE FRONT PARKING/TURN AND SIDE MARKER LAMPS

PINPOINT TEST AL: THE EXTERIOR LAMP(S) ARE INOPERATIVE FRONT PARKING/TURN, SIDE MARKER, AND LOW BEAM LAMPS

PINPOINT TEST AM: THE PARKING, REAR OR LICENSE LAMP IS ON CONTINUOUSLY FRONT PARKING AND MARKER LAMPS

PINPOINT TEST AN: ONE OR MORE PARKING, REAR, OR LICENSE LAMP IS ON CONTINUOUSLY LICENSE LAMPS

PINPOINT TEST AO: ONE OR MORE PARKING, REAR, OR LICENSE LAMP IS ON CONTINUOUSLY LR PARKING LAMPS

PINPOINT TEST AP: ONE OR MORE PARKING, REAR, OR LICENSE LAMP IS ON CONTINUOUSLY RR PARKING LAMPS

PINPOINT TEST AH: ONE OR MORE PARKING, REAR OR LICENSE LAMP IS INOPERATIVE RIGHT R

Fog Lamps

Refer to Wiring Diagrams Cell 86 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool
 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Principles of Operation

NOTE: The front electronic module (FEM), the rear electronic module (REM), and the instrument cluster module (ICM) must be reconfigured before installing a new module. Refer to Section 418-01 .

The vehicle electronic functions are divided into zones. The FEM controls the front portion of the vehicle and the REM controls the rear portion of the vehicle. These systems rely heavily on the standard corporate protocol (SCP) communication network in order to transmit and receive signals. As a technician it is very important to understand:

- where the input (command) originates from.
- all information (messages) necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input (message) control the output of the feature, or does it output a message over the SCP communication network to another module.
- which module controls the output of the feature.

Exterior Lighting

The exterior lighting outputs are zone controlled by the FEM and REM. The front exterior lights are controlled by the FEM and the rear exterior lights are controlled by the REM. An additional function of the lighting system is a lamp outage function which indicates to the driver if certain exterior bulbs are not functioning. With a bulb inoperative, the FEM or REM will send a message to the instrument cluster and message center (if equipped with the message center), which will indicate to the driver that the lamp is inoperative with a lamp out indicator (with the message center a message will be displayed). To provide complete input and output functionality, each exterior lamp feature will be described individually. All exterior lighting is powered by the switched system power (SSP) feature (refer to Switched System Power [SSP]). A failure of all or any of the SSP features will cause inoperative exterior lighting. When diagnosing exterior lighting, it is essential to determine if all related symptoms and DTCs are controlled by the SSP feature.

The vehicle's electronic functions are divided into zones. The FEM controls the front portion of the vehicle and the REM controls the rear portion of the vehicle. These systems rely heavily on the SCP communication network in order to transmit and receive signals. As a technician it is very important to understand:

- where the input (command) originates from.
- all information (messages) necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input (message), control the output of the feature, or does it output a message over the SCP communication network to another module.
- which module controls the output of the feature.

Fog Lamps

The fog lamps are controlled by the headlamp switch. The switch toggles the fog lamps between on and off. When activated, the switch sends voltage to the instrument cluster. The instrument cluster sends a signal to the FEM which activates the fog lamp.

The vehicles electronic functions are divided into zones. The FEM controls the front portion of the vehicle and the REM controls the rear portion of the vehicle. These systems rely heavily on the SCP communication network in order to transmit and receive signals. As a technician it is very important to understand:

- where the input (command) originates from.
- all information (messages) necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- whether module which received the input (message) controls the output of the feature, or whether it outputs a message over the SCP communication network to another module.
- which module controls the output of the feature.

Switched System Power (SSP)

The SSP is invoked by both the FEM and REM. This function removes power from relays that provide power to the exterior lamps, interior lamps, and power door locks. This is only accomplished when both the FEM and the REM are in sleep mode. The sleep function of the FEM and REM places the modules in sleep mode when the ignition switch is in the OFF position, and no wake up (input) signals occur for 30 minutes. The module will not sleep if the parking lamps or the hazard lamps are active. The following relays are controlled by the SSP function: SSP1, SSP2, SSP3, and SSP4. When either the FEM or REM are not in sleep mode, all SSP relays will be energized. When energized, each relay will supply power to multiple features/functions. For additional information, go to the SSP Index for diagnosis and testing of SSP related issues. Refer to Headlamps .

Inspection and Verification

1. Verify the customer concern by operating the fog lamps following these steps:
    1. Place the ignition switch (11572) in the ON position.
    2. Place the headlamp switch (11564) in the ON position.
    3. Place the fog lamp switch in the ON position.
    4. Verify the fog lamp operation.
    5. Place the headlamps in the OFF position.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical

• Damaged FEM • Damaged instrument cluster (10849)	• Battery junction box (BJB) Fuses: ♦ 422 (20A) ♦ 423 (30A) ♦ 424 (30A) ♦ 425 (40A) ♦ 427 (30A) ♦ 432 (30A) • Central junction box (CJB) Fuse: ♦ 213 (5A) ♦ 220 (5A) • Underhood auxiliary junction box UAJB Fuses: ♦ 103 (15A) • Damaged wiring harness • Loose or corroded connections • Damaged headlamp switch

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTIC TEST. If the diagnostic tool responds with:
   - CKT914, CKT915 or CKT70 =ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for FEM, go to Pinpoint Test A.
   - NO RESP/NOT EQUIP for instrument cluster, go to Pinpoint Test C.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the FEM.

6. If the DTCs retrieved are related to the concern, go to FEM Diagnostic Trouble Code (DTC) Index, and Instrument Cluster Diagnostic Trouble Code (DTC) Index, or SSP Relay Index to continue diagnostics. Refer to Headlamps .

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

Symptom Chart

Symptom Chart

Pinpoint Test

PINPOINT TEST AQ: THE FOG LAMPS ARE INOPERATIVE

PINPOINT TEST AR: THE INDIVIDUAL FOG LAMP IS INOPERATIVE

PINPOINT TEST AS: THE FOG LAMPS ARE ON CONTINUOUSLY

Reversing Lamps

Refer to Wiring Diagrams Cell 93 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool
 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Principles of Operation

NOTE: The front electronic module (FEM), the rear electronic module (REM) and the instrument cluster module (ICM) must be reconfigured before installing a new module. Refer to Section 418-01 .

The vehicle's electronic functions are divided into zones. The FEM controls the front portion of the vehicle and the REM controls the rear portion of the vehicle. These systems rely heavily on the standard corporate protocol (SCP) communication network in order to transmit and receive signals. As a technician it is very important to understand:

- where the input (command) originates from.
- all information (messages) necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input (message), control the output of the feature, or does it output a message over the SCP communication network to another module.
- which module controls the output of the feature.

Exterior Lighting

The exterior lighting outputs are zone controlled by the FEM and REM. The front exterior lights are controlled by the FEM and the rear exterior lights are controlled by the REM. An additional function of the lighting system is a lamp outage function which indicates to the driver if certain exterior bulbs are not functioning. With a bulb inoperative, the FEM or REM will send a message to the instrument cluster and message center (if equipped with the message center), which will indicate to the driver that the lamp is inoperative with a lamp out indicator (with the message center a message will be displayed). To provide complete input and output functionality, each exterior lamp feature will be described individually. All exterior lighting is powered by the switched system power (SSP) feature (refer to Switched System Power [SSP]). A failure of all or any of the SSP features will cause inoperative exterior lighting. When diagnosing exterior lighting, it is essential to determine if all related symptoms and DTCs are controlled by the SSP feature.

Reversing Lamps

The reversing lamps are controlled by the REM and PCM. The PCM sends a message through the SCP communication network to the REM indicating the transmission has been placed in REVERSE. The REM

will process this information and output the command to the reversing lamps which are hardwired to the REM. Fault management of the reversing lamps will provide limited reversing lamp functionality. In the event of a transmission missing or invalid data, the reversing lamps will remain in the last state of operation prior to the failure for one key cycle. In the event of invalid or missing data for the ignition switch, the lamps will work in relation to PRNDL messages.

The vehicle's electronic functions are divided into zones. The FEM controls the front portion of the vehicle and the REM controls the rear portion of the vehicle. These systems rely heavily on the SCP communication network in order to transmit and receive signals. As a technician it is very important to understand:

- where the input (command) originates from.
- all information (messages) necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input (message), control the output of the feature, or does it output a message over the SCP communication network to another module.
- which module controls the output of the feature.

Switched System Power (SSP)

The SSP is invoked by both the FEM and REM. This function removes power from relays that provide power to the exterior lamps, interior lamps, and power door locks. This is only accomplished when both the FEM and the REM are in sleep mode. The sleep function of the FEM and REM places the modules in sleep mode when the ignition switch is in the OFF position, and no wake up (input) signals occur for 30 minutes. The module will not sleep if the parking lamps or the hazard lamps are active. The following relays are controlled by the SSP function: SSP1, SSP2, SSP3, and SSP4. When either the FEM or REM are not in sleep mode, all SSP relays will be energized. When energized, each relay will supply power to multiple features/functions. For additional information, go to the SSP Index for diagnosis and testing of SSP related issues. Refer to Headlamps .

Inspection and Verification

1. Verify the customer concern by operating the turn signal, cornering, and hazard lamps.

2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged REM	• Battery junction box (BJB) Fuses: ♦ 406 (10A) ♦ 423 (30A) ♦ 424 (30A) ♦ 425 (40A) ♦ 427 (30A) ♦ 432 (30A) • Damaged wiring harness • Loose or corroded connections

	• Damaged bulbs

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTIC TEST. If the diagnostic tool responds with:
   - CKT914, CKT915 or CKT70 =ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for REM, go to Pinpoint Test B.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the REM.

6. If the DTCs retrieved are related to the concern, go to REM Diagnostic Trouble Code (DTC) Index, or SSP Relay Index to continue diagnostics. Refer to Headlamps .

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

Symptom Chart

Symptom Chart
Pinpoint Tests

PINPOINT TEST AT: THE REVERSING LAMPS ARE INOPERATIVE

PINPOINT TEST AU: THE INDIVIDUAL REVERSING LAMP IS INOPERATIVE LH REVERSING LAMP

PINPOINT TEST AV: THE INDIVIDUAL REVERSING LAMP IS INOPERATIVE RH REVERSING LAMP

PINPOINT TEST AW: THE REVERSING LAMPS ARE ON CONTINUOUSLY

Trailer Lamps

Refer to Wiring Diagrams Cell 95 for schematic and connector information.

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool
 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Principles of Operation

NOTE: The front electronic module (FEM), the rear electronic module (REM), and the instrument cluster module (ICM) must be reconfigured before installing a new module. Refer to Section 418-01 .

The vehicle electronic functions are divided into zones. The FEM controls the front portion of the vehicle and the REM controls the rear portion of the vehicle. These systems rely heavily on the standard corporate protocol (SCP) communication network in order to transmit and receive signals. As a technician it is very important to understand:

- where the input (command) originates from.
- all information (messages) necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- does the module which received the input (message), control the output of the feature, or does it output a message over the SCP communication network to another module.
- which module controls the output of the feature.

Trailer Tow

The trailer lighting is controlled by the trailer tow module (TTM) (if equipped). The architecture of the vehicle lighting system requires the TTM to be used for correct trailer lighting operation. The TTM controls the park, turn, and stoplamps of the trailer lighting when connected. Trailer lighting is powered through the trailer tow relay and trailer tow auxiliary junction box (TTAJB). The TTM, which is hardwired to the rear electronics module (REM), senses the vehicle's rear exterior park, turn, and stoplamps. For turn lamp operation, when either turn lamp is activated, the TTM will apply power to the appropriate trailer turn lamp(s). For stoplamps operation, the TTM senses the vehicle right rear stoplamps only, and when activated, the TTM will apply power to both trailer stoplamps. For tail lamp operation, the TTM senses the vehicle right rear lamp only, and when activated, the TTM will apply power to the trailer tail lamps.

Switched System Power (SSP)

The SSP is invoked by both the FEM and REM. This function removes power from relays that provide power to the exterior lamps, interior lamps, and power door locks. This is only accomplished when both the FEM and the REM are in sleep mode. The sleep function of the FEM and REM places the modules in sleep mode

when the ignition switch is in the OFF position, and no wake up (input) signals occur for 30 minutes. The module will not sleep if the parking lamps or the hazard lamps are active. The following relays are controlled by the SSP function: SSP1, SSP2, SSP3, and SSP4. When either the FEM or REM are not in sleep mode, all SSP relays will be energized. When energized, each relay will supply power to multiple features/functions. For additional information, go to the SSP Index for diagnosis and testing of SSP related concerns. Refer to Headlamps .

Inspection and Verification

1. Verify the customer concern by operating the vehicle stoplamps, turn signals and rear lamps. If the vehicle exterior lamps do not operate correctly, refer to Stoplamps , Turn Signal and Hazard Lamps , or Parking, Rear and License Lamps in this section.

2. Visually inspect for obvious signs of mechanical and electrical damage.

3. If the vehicle exterior lamps operate correctly, verify the operation of the trailer stoplamps, turn signals and tail lamps.

Visual Inspection Chart

Mechanical	Electrical
• Damaged TTM • Damaged bulbs • Damaged trailer tow (TT) relay • Damaged or corroded wiring	• Battery junction box (BJB) Fuses: ♦ 423 (30A) ♦ 424 (30A) ♦ 427 (30A) ♦ 432 (30A) • TTAJB fuses 433 (15A), 434 (15A)

4. If the concern remains after the inspection, proceed to Symptom Chart to continue diagnostics.

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST AX: THE TRAILER LAMPS ARE INOPERATIVE ALL

PINPOINT TEST AY: THE TRAILER LAMPS ARE INOPERATIVE REAR LAMPS

PINPOINT TEST AZ: THE TRAILER LAMPS ARE INOPERATIVE ANY STOP OR TURN LAMP

PINPOINT TEST BA: THE TRAILER LAMPS ARE ALWAYS ON ALL

Headlamp Adjustment

Headlamp Aiming

1. The headlamp aiming procedure depends on the type of beam pattern the headlamp is equipped with. Vehicles may come equipped with visual optical right (VOR), visual optical left (VOL), or SAE only (includes sealed beam type) headlamps. To identify the headlamp beam pattern, look on the headlamp lens. Molded in small letters on the headlamp lens is one of the following:
    - SAE
    - VOR or SAE
    - VOL or SAE

2. Once the headlamp beam pattern is identified, aim the headlamps using one of the following methods as applicable.
    - Photometric aimers can aim SAE, VOR and VOL type headlamps. This is the preferred method of headlamp aiming.
    - Visual or screen method aiming can be used to aim SAE, VOR and VOL type headlamps.
    - Mechanical aimers can be used only with SAE type headlamps. Lamps that can be aimed mechanically will have three nibs molded into the lens of the lamp.

Photometric Aiming

1. For the photometric aiming procedure, refer to the appropriate photometric headlamp aimer instruction manual.

Screen Method Aiming

All headlamp types

NOTE: Horizontal aim is not necessary for VOR or VOL headlamps.

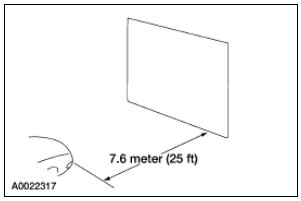
NOTE: Consult your state vehicle inspection manual for recommended tolerance ranges for visual aiming.

NOTE: The sight shield may need to be positioned or removed for access to the adjusters.

1. Before starting headlamp adjustment:
    - Check the tire inflation.
    - Check that no other load is in the vehicle other than a half tank of fuel.
    - Check that the headlamps are clean.
    - Check for correct headlamp operation.
    - Check that the vehicle is on level ground.
    - If the vehicle is equipped with air suspension, make sure that the switch is on.

2. **NOTE:** The vertical wall or screen must be a minimum of 2.4 meters (8 feet) wide.

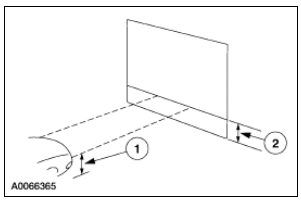
   Park the vehicle on a level surface approximately 7.6 meters (25 feet) from the vertical wall or screen directly in front of it.



3. **NOTE:** The center of the lamp is marked by a 3 mm (0.12 in) circle on the headlamp lens.

   Mark a horizontal reference line on the vertical wall or screen.

   1. Measure the center of the headlamp height to ground and record.
   2. Make a 2.4 meter (8 foot) horizontal mark (masking tape) on the vertical wall or screen at the same distance from the ground as previously recorded.



4. **NOTE:** This procedure should be done in a dark environment to effectively see the headlamp beam pattern.

   Turn on the low beam headlamps to illuminate the wall or screen and open the hood.

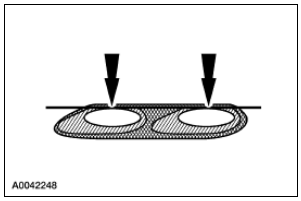
5. **NOTE:** For SAE type headlamps, the appearance of the beam pattern may vary between vehicles.

   On the wall or screen, locate the high intensity area of the beam pattern. Place the top edge of the high intensity zone even with the horizontal reference line.

VOR type headlamps

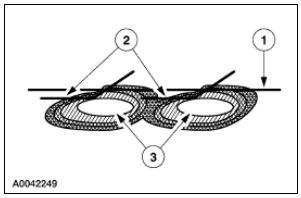
6. **NOTE:** The appearance of the VOR beam pattern may vary between vehicles.

   Identify at the top edge of this high intensity area a distinct horizontal cutoff in the beam pattern. If the top edge of this cutoff is not even with the horizontal reference line, the headlamp beam will need to be adjusted.



VOL type headlamps

7. For VOL type headlamps, there will be a distinct cutoff in the left portion of the beam pattern. The edge of this cutoff should be positioned 50.2 mm (2 in) below the horizontal reference line.
   1. Horizontal reference line.
   2. Top edge of the beam pattern.
   3. High intensity zone.



Mechanical Aiming

1. For the mechanical aiming procedure, refer to the appropriate mechanical headlamp aimer instruction manual.

Bulb Headlamp

Removal and Installation

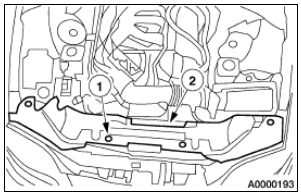
1. ⚠ **WARNING: The halogen bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Avoid touching the glass envelope.**

   NOTE: The headlamp bulb should not be removed from the headlamp assembly until just before a replacement bulb is installed. Removing the bulb for an extended period of time may affect headlamp bulb performance. Contaminants may enter the headlamp assembly where they can settle on the lens and reflector. Never turn on the headlamps with the bulb removed.

   NOTE: Make sure that the headlamp switch and the ignition switch are in the OFF position.

   Remove the radiator upper sight shield.

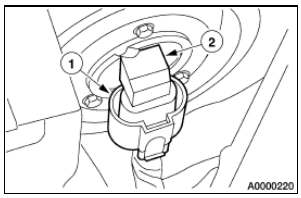
   1. Remove the pin-type retainers.
   2. Remove the radiator upper sight shield.



2. **NOTE:** Remove both the high and low beam headlamp bulbs in the same way.

   Remove the headlamp bulb.

   1. Disconnect the electrical connector.
   2. Remove the headlamp bulb.



3. To install, reverse the removal procedure.

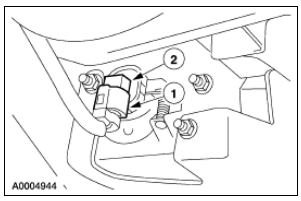
Bulb Fog Lamp

Removal and Installation

1. ⚠ **WARNING: The halogen fog lamp bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Avoid touching the glass envelope.**

   Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Remove the fog lamp bulb.
   1. Disconnect the electrical connector.
   2. Remove the fog lamp bulb.



3. To install, reverse the removal procedure.

Lamp Assembly Headlamp

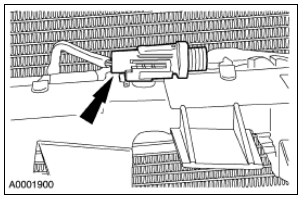
Removal and Installation

⚠ WARNING: The halogen fog lamp bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Avoid touching the glass envelope.

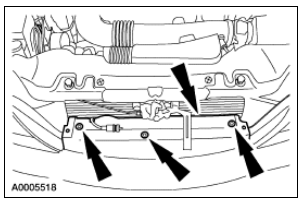
NOTE: The headlamp bulb should not be removed from the headlamp assembly until just before a replacement bulb is installed. Removing the bolt for an extended period of time may affect headlamp bulb performance. Contaminants may enter the headlamp assembly where they can settle on the lens and reflector. Never turn on the headlamps with the bulb removed.

1. **NOTE:** Make sure that the headlamp switch and the ignition switch are in the OFF position.

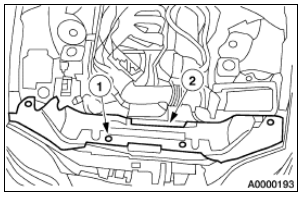
   Release the ambient air temperature sensor.



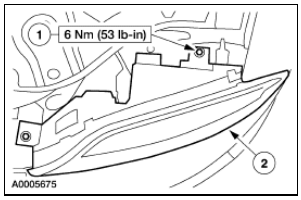
2. Remove the radiator grille opening cover at the top shelf of the bumper.



3. Remove the radiator upper sight shield.
   1. Remove the pin-type retainers.
   2. Remove the radiator upper sight shield.



4. Position the headlamp assembly for removal.
   1. Remove the three bolts.
   2. Position the headlamp assembly for removal.
      - Disconnect the electrical connectors and remove the headlamp assembly.



5. To install, reverse the removal procedure.
    - If necessary, install new bulbs.
    - If necessary, adjust the headlamps. For additional information, refer to Headlamp Adjustment in this section.

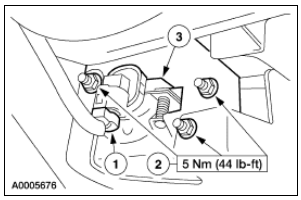
Lamp Assembly Fog Lamp

Removal and Installation

1. ⚠ **WARNING: The halogen fog lamp bulb contains gas under pressure. The bulb may shatter if the glass envelope is scratched or if the bulb is dropped. Handle the bulb only by its base. Avoid touching the glass envelope.**

   Raise and support the vehicle. For additional information, refer to Section 100-02 .

2. Remove the fog lamp assembly.
   1. Disconnect the electrical connector.
   2. Remove the nuts.
   3. Remove the fog lamp assembly.
   - If necessary, install a new bulb.

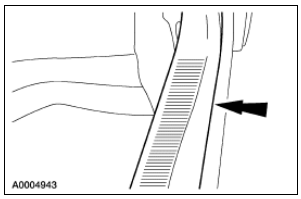


3. To install, reverse the removal procedure.

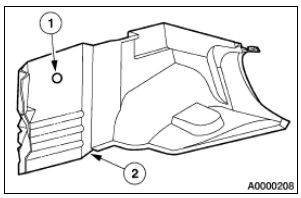
Lamp Assembly Stoplamp

Removal and Installation

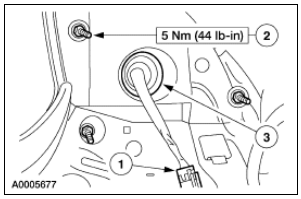
1. Remove the luggage compartment scuff plate.
   - Pull to unsnap.



2. Position the luggage compartment side trim panel aside.
   1. Remove the pin-type retainers.
   2. Position the luggage compartment side trim panel aside.



3. Remove the stoplamp assembly.
   1. Disconnect the electrical connector.
   2. Remove the three nuts.
   3. Push the rubber grommet through the sheet metal and remove the stoplamp assembly.
   - If necessary, install new bulbs.

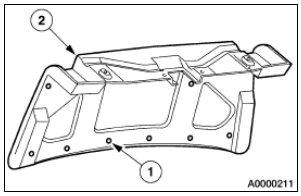


4. To install, reverse the removal procedure.

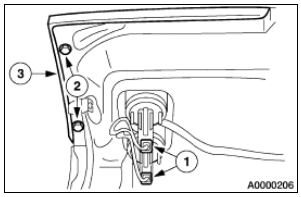
Lamp Assembly Rear

Removal and Installation

1. Remove the luggage compartment door trim panel.
    1. Remove the 13 pin-type retainers.
    2. Remove the luggage compartment door trim panel.



2. Remove the rear lamp assembly.
    1. Disconnect the electrical connectors.
    2. Remove the nuts.
    3. Remove the rear lamp assembly.
    - If necessary, install new bulbs.



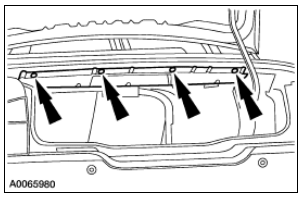
3. To install, reverse the removal procedure.

Lamp Assembly High Mounted Stoplamp

Removal and Installation

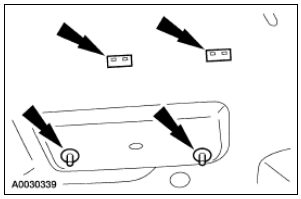
1. Remove the carpeted package tray trim panel. For additional information, refer to Section 501-05 .

2. Remove the upper luggage compartment trim panel.
   - Remove the pin-type retainers.



3. ⚠ **CAUTION: Exercise care not to break the locator pins, which are positioned on the high mounted stoplamp assembly at the rear of the vehicle.**

   Depress the two retaining tabs from the inside of the luggage compartment.



4. Lift the high mounted stoplamp up to clear the locator pins and remove the stoplamp assembly.

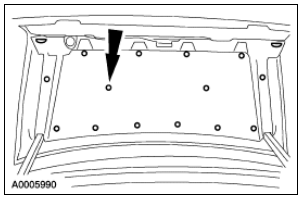
5. To install, reverse the removal procedure.

License Plate Lamp

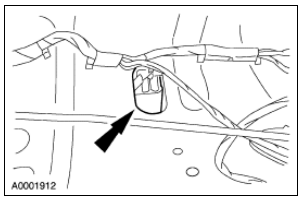
Removal and Installation

1. If necessary, remove the license plate.

2. Remove the pin-type retainers and the luggage compartment lid trim panel.

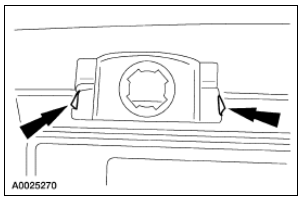


3. Disconnect the license plate lamp electrical connector.



4. Remove the lamp socket from the license plate lamp.

5. Using a suitable tool, through the access hole, release the clips and remove the license plate lamp.



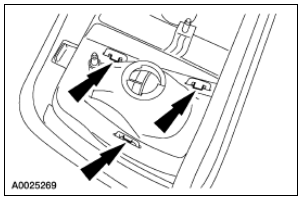
6. To install, reverse the removal procedure.

Reversing Lamp

Removal and Installation

1. Remove the license plate housing. For additional information, refer to section Section 501-08 .

2. Release the clips and remove the reversing lamp.



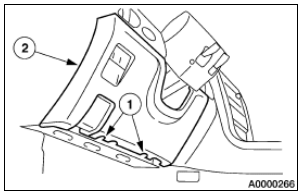
3. To install, reverse the removal procedure.

Lamp Switch Headlamp

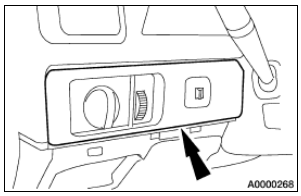
Removal and Installation

1. Disconnect the battery ground cable. Refer to Section 414-01 .

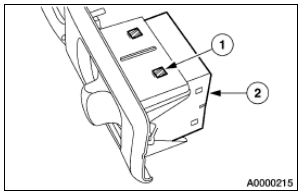
2. Remove the instrument panel steering column cover.
    1. Remove the screws.
    2. Remove the instrument panel steering column cover.
    - Disconnect the electrical connectors.



3. Remove the outer instrument panel finish panel.
    - Disconnect the electrical connector.



4. Remove the headlamp switch.
    1. Release the four retaining clips.
    2. Remove the headlamp switch.



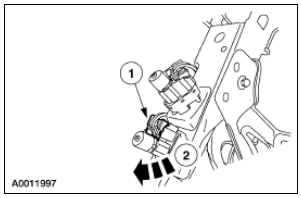
5. To install, reverse the removal procedure.

Lamp Switch Brake Pedal Position (BPP)

Removal

1. Remove the instrument panel insulator.
   - Disconnect electrical connector.

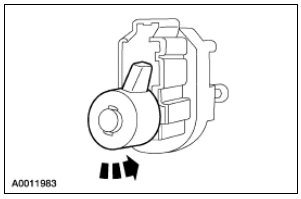
2. Remove the brake pedal position (BPP) switch.
   1. Disconnect the electrical connector.
   2. Remove the BPP switch.



Installation

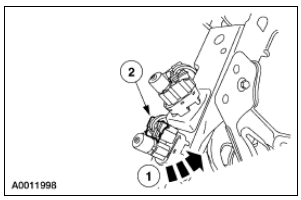
⚠ CAUTION: Initial installation of a brake pedal position (BPP) switch allows for one adjustment. If additional adjustments are required, install a new switch.

1. Rotate the lock knob counterclockwise to the stop to unlock.



2. With the engine running, fully depress and hold the brake pedal.

3. Install the BPP switch.
   1. Position the BPP switch in the bracket and rotate counterclockwise.
   2. Connect the electrical connector.



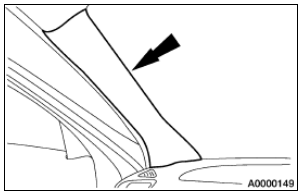
4. Slowly release the brake pedal.

Photocell and Amplifier Light Sensor

Removal and Installation

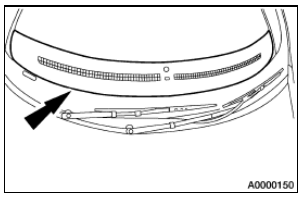
1. Disconnect the battery ground cable. Refer to Section 414-01 .

2. Remove the RH and LH windshield side garnish mouldings.

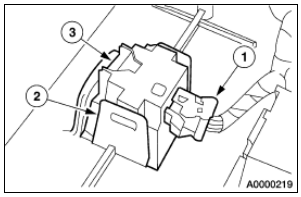


3. **⚠ CAUTION: To avoid damaging the photocell and amplifier electrical connector, lift the instrument panel defroster opening grille assembly only enough to expose the connector.**

   Remove the instrument panel defroster opening grille assembly.



4. Remove the photocell and amplifier.
   1. Disconnect the electrical connector.
   2. Release the two retaining clips.
   3. Remove the photocell and amplifier.



5. To install, reverse the removal procedure.

Interior Lighting

The interior lighting system consists of:

- driver and passenger front door lamp (integral to the door trim panel)
- left and right instrument panel lamps
- rear dome lamp (integral to the headliner)
- left and right front map lamps (integral to the headliner)
- rear map lamps
- deck lid lamp
- glove box lamp
- inside console lamp
- driver and passenger vanity lamp

Interior Lighting

Refer to Wiring Diagrams Cell 89 for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Principles of Operation

NOTE: The front electronic module (FEM), rear electronic module (REM), and driver door module (DDM) must all be reconfigured before installing a new module. REFER to Section 418-01 .

The vehicle's electronic functions are divided into zones. The FEM controls the front portion of the vehicle and the REM controls the rear portion of the vehicle. These systems rely heavily on the standard corporate protocol (SCP) communication network in order to transmit and receive signals. As a technician, it is very important to understand:

- where the input (command) originates from.
- all information (messages) necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- whether the module which received the input (message) controls the output of the feature, or whether it outputs a message over the SCP communication network to another module.
- which module controls the output of the feature.

FEM Operation

This system is unique in that many of the inputs the FEM receives are delivered via the SCP communication network. These input messages come from other modules connected to the network, such as the REM, DDM, and instrument cluster. The FEM will interpret the inputs and, in turn, command the correct output. The FEM also receives inputs which come directly from components which are hardwired to the module, such as the passenger door ajar switch.

Interior Lighting

The FEM controls the outputs to all interior lighting. The interior lamps include: courtesy lamps, dome lamps, and map lamps. The lamps will be illuminated if the driver or front passenger door is ajar. The switches are hardwired to the FEM. When any of the two doors are opened, the FEM will command the interior lamps through the SCP network to the FEM. The right and left rear ajar switches are hardwired to the REM. When any of these doors are ajar, the REM will send a command through the SCP network, to the FEM. The FEM will command the appropriate interior lamps on.

The FEM also handles the grounds for the glove box and the visor lamps. Fault management of the interior lamps will provide limited functionality in the event of certain dome or lighting mode inputs, vehicle speed or ignition switch failures. All interior lighting is powered by the switched system power (SSP) feature (refer to Switched System Power). A failure of any or all of the SSP feature(s) could cause inoperative interior lighting. When diagnosing the interior lighting, it is essential to determine if all relative symptoms and DTCs are controlled by the SSP feature.

Switched System Power (SSP)

The SSP is invoked by both the FEM and REM. This function removes power from relays that provide power to the exterior lamps, interior lamps, and power door locks. This is only accomplished when both the FEM and the REM are in sleep mode. The sleep function of the FEM and REM places the modules in sleep mode when the ignition switch is in the OFF position, and no wake up (inputs) signals occur for 30 minutes. The module will not sleep if the parking lamps or the hazard lamps are active. The following relays are controlled by the SSP function: SSP1, SSP2, SSP3, and SSP4. When either the FEM or REM are not in sleep mode, all SSP relays will be energized. Each relay, when energized, will supply power to multiple features/functions. For additional information, refer to the SSP Relay Index for diagnosis and testing of SSP-related issues.

Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Electrical
• Wiring harness • Loose or corroded connections • Battery junction box (BJB) Fuses: ♦ 404 (10A) ♦ 405 (10A) ♦ 422 (20A) ♦ 425 (40A) ♦ 423 (30A) ♦ 424 (30A) ♦ 430 (30A) ♦ 431 (30A) • Central junction box (CJB) Fuses: ♦ 207 (5A) ♦ 220 (10A) ♦ 222 (10A) ♦ 235 (5A) • Lamp(s) • Relay(s) • Headlamp switch • Instrument cluster

- Dimmer switch
- FEM
- REM
- DDM

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
    - Check that the program card is correctly installed.
    - Check the connections to the vehicle.
    - Check the ignition switch position.

4. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:
    - CKT914, CKT915 or CKT70 =ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
    - NO RESP/NOT EQUIP for FEM, go to Pinpoint Test A.
    - NO RESP/NOT EQUIP for REM, go to Pinpoint Test B.
    - NO RESP/NOT EQUIP for DDM, go to Pinpoint Test C.
    - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the FEM.

6. If the DTCs retrieved are related to the concern, go to FEM Diagnostic Trouble Code (DTC) Index or REM Diagnostic Trouble Code (DTC) Index.

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

FEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1319	Driver Door Ajar Circuit Failure	FEM	GO to Pinpoint Test F .
B1327	Passenger Door Ajar Circuit Failure	FEM	GO to Pinpoint Test F .
B1342	ECU Is Defective	FEM	CLEAR the DTC. REPEAT the FEM self-test. If DTC B1342 is retrieved, INSTALL a new FEM. REFER to Section 419-10 .
B1438	Wiper Mode Select Switch Circuit Failure	FEM	REFER to Section 501-16 .
B1446	Wiper Park Sense Circuit Failure	FEM	REFER to Section 501-16 .
B1479	Wiper Washer Fluid Level Sensor Circuit Failure	FEM	REFER to Section 413-01 .
B1499	Lamp Turn Signal Left Circuit Failure	FEM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1503	Lamp Turn Signal Right Circuit Failure	FEM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	FEM	REFER to Section 417-01 .

B1519	Hood Switch Circuit Failure	FEM	REFER to Section 419-01A .
B1567	Lamp Headlamp High Beam Circuit Failure	FEM	REFER to Section 417-01 .
B1676	Battery Pack Voltage Out of Range	FEM	REFER to Section 414-00 .
B1794	Lamp Headlamp Low Beam Circuit Failure	FEM	REFER to Section 417-01 .
B2214	Window Passenger Front Up Switch Short to Battery	FEM	REFER to Section 501-11 .
B2215	Window Passenger Front Down Switch Short to Battery	FEM	REFER to Section 501-11 .
B2312	Mirror Passenger Horizontal Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2316	Mirror Passenger Vertical Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2477	Module Configuration Failure	FEM	REFER to Section 418-01 .
C1284	Oil Pressure Switch Failure	FEM	REFER to Section 413-01 .
C1446	Brake Switch Circuit Failure	FEM	REFER to Section 413-01 .
C1924	VAPS Solenoid Actuator Output Circuit Short to Ground	FEM	REFER to Section 211-00 .
C1925	VAPS Solenoid Actuator Return Circuit Failure	FEM	REFER to Section 211-00 .
U1027	SCP (J1850) Invalid or Missing Data for Engine RPM	PCM	CARRY OUT the PCM self-test. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test. REFER to Section 206-09A , Section 206-09B , or Section 206-09C .
U1059	SCP (J1850) Invalid or Missing Data for Transmission / Transaxle / PRNDL	PCM	CARRY OUT the PCM self-test. REFER toPowertrain Control/Emissions Diagnosis (PC/ED) manual..
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the ICM self-test. REFER to Section 413-01 .
U1222	SCP (J1850) Invalid or Missing Data for Interior Lamps	ICM	CARRY OUT the ICM self-test. REFER to Section 413-01 .
U1227	SCP (J1850) Invalid or Missing Data for Body Status Request	ICM	CARRY OUT the ICM self-test. REFER to Section 413-01 .

REM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1201	Fuel Sender Circuit Failure	REM	REFER to Section 413-01 .
B1300	Power Door Lock Circuit Failure	REM	REFER to Section 501-14B .
B1310	Power Door Unlock Circuit Failure	REM	REFER to Section 501-14B .
B1331	Decklid Ajar Rear Door Circuit Failure	REM	GO to Pinpoint Test J .
B1335	Door Ajar RR Circuit Failure	REM	GO to Pinpoint Test F .
B1342	ECU Is Defective	REM	CLEAR the DTC. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new REM. REFER

			to Section 419-10 .
B1483	Brake Pedal Input Circuit Failure	REM	REFER to Section 417-01 .
B1499	Lamp Turn Signal Left Circuit Failure	REM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	REM	REFER to Section 417-01 .
B1503	Lamp Turn Signal Right Circuit Failure	REM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	REM	REFER to Section 417-01 .
B1551	Decklid Release Circuit Failure	REM	REFER to Section 501-14B .
B1571	Door Ajar LR Circuit Failure	REM	GO to Pinpoint Test F .
B1676	Battery Pack Voltage Out of Range	REM	REFER to Section 414-00 .
B2172	Inertia Switch input Circuit Open	REM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
B2174	Window Driver Rear Remote Up Switch Short to Battery	REM	REFER to Section 501-16 .
B2178	Window Driver Rear Remote Down Switch Short to Battery	REM	REFER to Section 501-16 .
B2190	Window Passenger Rear Remote Up Switch Short to Battery	REM	REFER to Section 501-16 .
B2194	Window Passenger Rear Remote Down Switch Short to Battery	REM	REFER to Section 501-16 .
B2477	Module Configuration Failure	REM	REFER to Section 418-01 .
U1059	SCP (J1850) Invalid or missing Data for Transmission/Transaxle/ PRNDL	PCM	CARRY OUT the PCM self-test. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the ABS self-test.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the ICM self-test.

DDM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1309	Power Door Lock Circuit Short to Ground	DDM	REFER to Section 501-14B .
B1341	Power Door Unlock Circuit Short to Ground	DDM	REFER to Section 501-14B .
B1342	ECU Is Defective	DDM	CLEAR the DTC. REPEAT the DDM self-test. If DTC B1342 is retrieved, INSTALL a new DDM. REFER to Section 419-10 .
B1400	Driver Power Window One Touch Window Relay Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1405	Driver Power Window Down Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1408	Driver Power Window Up Circuit	DDM	REFER to Section 501-11 .

	Short to Battery		
B1416	Power Window LR Motor Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1420	Passenger Power Window Motor Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1424	Power Window RR Motor Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1530	Memory Set Switch Circuit Short to Ground	DDM	REFER to Section 501-10 .
B1534	Memory 1 Switch Circuit Short to Ground	DDM	REFER to Section 501-10 .
B1538	Memory 2 Switch Circuit Short to Ground	DDM	REFER to Section 501-10 .
B1676	Battery Pack Voltage Out of Range	DDM	REFER to Section 414-00 .
B2112	Door Driver Set Switch Stuck Failure	DDM	REFER to Section 501-14B .
B2116	Door Driver Reset Switch Stuck Failure	DDM	REFER to Section 501-14B .
B2320	Mirror Driver Horizontal Feedback Potentiometer Circuit Failure	DDM	REFER to Section 501-09 .
B2324	Mirror Driver Vertical Feedback Potentiometer Circuit Failure	DDM	REFER to Section 501-09 .
B2336	Mirror Switch Assembly Circuit Failure	DDM	REFER to Section 501-09 .
B2425	Remote Keyless Entry Out of Synchronization	DDM	REFER to Section 501-14B .
B2477	Module Configuration Failure	DDM	REFER to Section 418-01 .

SSP Relay Index

Relay	Fuse	Controlled System(s)
SSP1	BJB Fuse 427 (30A)	• Driver power door lock (FEM) • LH high beam headlamps (FEM) • RF park/turn/side marker lamps (FEM) • RH low beam headlamp • Driver exterior rear view mirror • LF park/turn/side marker lamps (FEM)
SSP2	BJB Fuse 432 (30A)	• LH low beam headlamp (FEM) • RH high beam headlamps (FEM) • Passenger exterior rear view mirror (FEM) • Switch illumination backlighting
SSP3	BJB Fuse 424 (30A)	•

		• High mounted stoplamp (REM) • RR park/stoplamps (REM) • Reversing lamps (REM) • LR turn signals (REM) • Interior courtesy and demand lighting (FEM)
SSP4	BJB Fuse 423 (30A)	• • LR park/stoplamps (REM) • RR turn signals (REM) • All passenger door locks (REM) • License lamps • Luggage compartment release solenoid/switch • Fuel door release solenoid/switch • Luggage compartment lamp

When diagnosing an SSP relay, check that all systems for that relay are inoperative. Refer to Section 417-01 .

Symptom Chart

Symptom Chart
Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE FRONT ELECTRONIC MODULE (FEM)

PINPOINT TEST B: NO COMMUNICATION WITH THE REAR ELECTRONIC MODULE (REM)

PINPOINT TEST C: NO COMMUNICATION WITH THE DRIVER DOOR MODULE (DDM)

PINPOINT TEST D: THE COURTESY LAMPS ARE INOPERATIVE ALL COURTESY AND INTERIOR LAMPS

PINPOINT TEST E: AN INDIVIDUAL COURTESY LAMP IS INOPERATIVE INDIVIDUAL AND MULTIPLE LAMPS

PINPOINT TEST F: THE COURTESY LAMPS STAY ON CONTINUOUSLY ALL COURTESY AND INTERIOR LAMPS

PINPOINT TEST G: THE DEMAND LAMPS STAY ON CONTINUOUSLY LEFT MAP, RIGHT MAP OR REAR DOME LAMP

PINPOINT TEST H: THE COURTESY LAMPS DO NOT TURN ON WITH ONE DOOR OPEN

PINPOINT TEST I: INDIVIDUAL DEMAND LAMP IS INOPERATIVE GLOVE COMPARTMENT, VANITY MIRROR(S), MAP OR REAR DOME LAMP

PINPOINT TEST J: THE COURTESY LAMP STAYS ON CONTINUOUSLY LUGGAGE COMPARTMENT LAMP ONLY

PINPOINT TEST K: THE COURTESY LAMPS DO NOT TURN ON WITH ONE DOOR OPEN LUGGAGE COMPARTMENT LID LAMP INOPERATIVE WITH LUGGAGE COMPARTMENT LID OPEN

Lamp Assembly Rear Reading

Removal and Installation

NOTE: The rear reading lamp assembly is an integral part of the headliner. This does not include the reading lamp lens and the bulbs.

For additional information, refer to Section 501-05 .

Lamp Assembly Front Map

Removal and Installation

NOTE: The front map lamp assembly is an integral part of the headliner. This does not include the front map lamp lens and bulbs.

For additional information, refer to Section 501-05 .

Daytime Running Lamps (DRL)

Refer to Wiring Diagrams Cell 87 for schematic and connector information.

Principles of Operation

The daytime running lamps (DRL) feature will illuminate the high beam headlamps, pulse width modulated at a 40% duty cycle when the following conditions exist:

- The ignition switch (11572) is in the RUN position.
- The headlamp switch (11654) is in the OFF or PARK position.
- The autolamps feature has not illuminated the parking lamps and the headlamps.

The headlamps are controlled by the front electronic module (FEM) and the instrument cluster (10849) in all phases of operation. The headlamp switch is hardwired to the instrument cluster, which sends a command through the standard corporate protocol (SCP) network to the FEM, which outputs the appropriate voltage to the headlamps. For additional information, refer to Section 417-01 .

Inspection and Verification

NOTE: The FEM must be reconfigured upon replacement. Refer to Section 418-01 .

1. Verify the customer concern by operating the DRL following these steps:
    1. Place the ignition switch in the RUN position.
    2. Place the autolamp switch in the OFF position.
    3. Place the headlamp switch in the OFF or PARK position.

2. Verify the parking lamp operation.
    1. Place the headlamp switch in the PARK position.
       If at least one of the parking lamps operates correctly, proceed to the next step.
       If none of the parking lamps operate, refer to Section 417-01 .

3. Verify the high beam headlamp operation.
    1. Place the headlamp switch in the ON position.
    2. Place the multifunction switch in the high beam headlamp position.
       If the high beam headlamp operation is correct and the DRL operation is incorrect, install a new FEM; refer to Section 419-10 .
       If the high beam operation is incorrect, refer to Section 417-01 .

-- I --

Identification Codes
DESC & OPER: Identification Codes

Section Table of Contents

Identification Tags

Idle Air Control (IAC) Valve - 3.0L

Idle Air Control (IAC) Valve - 3.9L

Ignition Coil

REM & INST: Engine Ignition - 3.0L (4V)

REM & INST: Engine Ignition - 3.9L

Ignition Switch Lock Cylinder

In-Vehicle Temperature Sensor

Inertia Fuel Shutoff (IFS) Switch

Information And Message Center

DESC & OPER: Information and Message Center

DIAG & TEST: Information and Message Center

Information and Message Center, Section Table of Contents

Inspection and Assembly Requirements - Following An A/C Compressor Failure

Inspection and Repair After a Supplemental Restraint System (SRS) Deployment

Instrument Cluster and Panel Illumination

DESC & OPER: Instrument Cluster and Panel Illumination

DIAG & TEST: Instrument Cluster and Panel Illumination

Section Table of Contents

Instrument Cluster

DESC & OPER: Instrument Cluster

DIAG & TEST: Instrument Cluster

REM & INST: Instrument Cluster

Section Table of Contents

Instrument Panel Air Distribution Ducts

Instrument Panel and Console, Section Table of Contents

Instrument Panel Cluster Finish Panel

Instrument Panel

DESC & OPER: Instrument Panel and Console

REM & INST: Instrument Panel and Console

Insulation

Intake Air Distribution And Filtering

DESC & OPER: Intake Air Distribution and Filtering

DIAG & TEST: Intake Air Distribution and Filtering

Intake Air Distribution and Filtering, Section Table of Contents

Intake Air Temperature (IAT) Sensor

Intake Manifold Tuning (IMT) Valve 3.0L

Intake Manifold

Interior Lighting

DESC & OPER: Interior Lighting

DIAG & TEST: Interior Lighting

Section Table of Contents

Interior Trim and Ornamentation, Section Table of Contents

Interior Trim

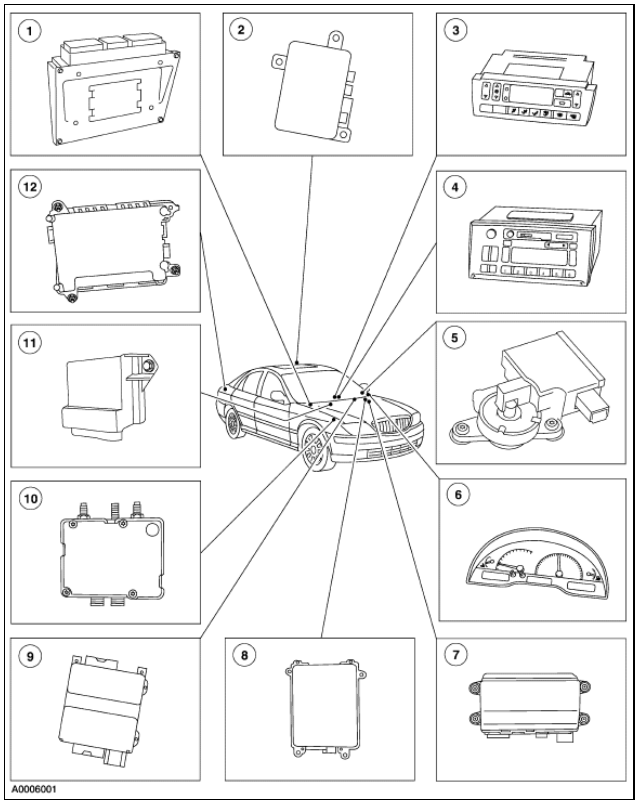
General Specifications

Item	Specification
Heat shrink tube overlap mm (inch)	12.7 (0.5)
Wire insulation removal length (twist side) mm (inch)	37.2 (1.5)
Wire insulation removal length (receiving side) mm (inch)	19.5 (0.75)
Raychem SCT® heat shrink tubing, Motorcraft part number WT-5627	ESB-M99056-AZ

Torque Specifications

Description	Nm	lb-in
Battery ground cable	10	89

Communications Network



Item	Part Number	Description
1	12A650	Powertrain control module (PCM)
2		Remote emergency satellite cellular unit (RESCU) module
3	18C612	Dual automatic temperature control (DATC) module
4		Audio control module (ACM)
5		Steering column lock module (SCLM)
6		Instrument cluster
7		Driver door module (DDM)
8	13B525	Front electronic module (FEM)
9		Driver seat module (DSM)
10		Anti-lock brake system (ABS)/traction control (TC) module/stability assist module
11		Restraint control module (RCM)
12	13B520	Rear electronic module (REM)

Communications Network

Refer to Wiring Diagrams Cell 14 , Multiplex Communication Network for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Principles of Operation

The vehicle has two module communication networks. The standard corporate protocol (SCP), which is an unshielded twisted pair cable: data bus plus and data bus minus, and the International Standards Organization (ISO) 9141 communications network, which is a single wire network. Both networks can be connected to the diagnostic tool by one connector called the data link connector (DLC). This makes troubleshooting these systems easier by allowing one smart tester to be able to diagnose and control any module on the two networks from one connector. The DLC can be found under the instrument panel, between the steering column and the radio.

The ISO 9141 communication network does not permit inter-module communication. When the diagnostic tool communicates to modules on the ISO 9141 communication network, the diagnostic tool must ask for all information; the modules cannot initiate communications.

The SCP communication network will remain operational even with the severing of one of the bus wires. Communications will also continue if one of the bus wires is shorted to ground or voltage, or if some, but not all, termination resistors are lost.

Unlike the SCP communication network, the ISO 9141 communication network will not function if the wire is shorted to ground or voltage. Also, if one of the modules on the ISO 9141 communication network loses power or shorts internally, communications to that module will fail.

The anti-lock brake control module is connected to the SCP communication network. The module comes in three types. The first type is the standard equipped anti-lock brake system (ABS). It controls the brake pressure to the four wheels to keep the vehicle under control while braking. For additional information, refer to Section 206-09A . The second type of ABS, if fitted, adds traction control to the anti-lock brake control module. For additional information, refer to Section 206-09B . The third type of ABS, if fitted, is called the stability assist module. This module adds yaw rate sensors, lateral accelerometer, and a steering angle rate sensor to the package to help in sensing a loss of vehicle control. For additional information, refer to Section 206-09C . All three types use the SCP communication network for diagnosis and communication between other SCP networked modules.

The audio control module (ACM) is connected to the SCP communication network and also to the audio control protocol (ACP) communication network. The ACM communicates with the compact disc player/changer and the cellular phone transceiver. For additional information on the compact disc player/changer, refer to Section 415-00 . For additional information on the cellular phone, refer to Section 419-05 .

The driver door module (DDM) is connected to the SCP communication network. The module controls many functions including power windows, power locks, and remote keyless entry. The DDM also communicates with the driver seat module (DSM) to control power seat and mirror memory. For additional information, refer to Section 501-14B .

The DSM is connected to the SCP communication network. The DSM controls the driver power seat. The module also communicates with the DDM to control the driver seat memory functions. For additional information, refer to Section 501-10 .

The dual automatic temperature control (DATC) module is connected to the SCP communication network. The DATC module controls automatic climate functions that maintain the vehicle at a constant temperature setting. For additional information, refer to Section 412-00 .

The instrument cluster (also known as an instrument cluster module [ICM]) is connected to the SCP communication network. The instrument cluster displays information received on the SCP including speedometer, odometer, fuel, and message center warnings. The instrument cluster also controls the passive anti-theft system (PATS). For additional information, refer to Section 413-00 for instrument cluster operation and Section 419-01B for PATS.

The front electronic module (FEM) and rear electronic module (REM) are connected to the SCP communication network. The FEM and REM controls both interior and exterior lighting and active anti-theft functions. For additional information on interior lamps, refer to Section 417-02 . For additional information on exterior lighting, refer to Section 417-01 . For additional information on active anti-theft, refer to Section 419-01A .

The powertrain control module (PCM) is connected to the SCP communication network. The PCM controls the engine performance, electronic ignition, emission controls, speed control, and on board diagnostics. For additional information, refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

The remote emergency satellite cellular unit (RESCU) module is connected to the SCP communication network. The module allows a user to request emergency assistance (police, ambulance, fire, wrecker) or directions to a desired location at the touch of a button. Also, if any of the vehicle's airbags are deployed while the RESCU System is powered ON, the system automatically issues a call for emergency assistance. For additional information, refer to Section 419-05 .

The steering column lock module (SCLM) is connected to the SCP communication network. The module controls locking of the steering column and is only equipped on vehicles with manual transmissions. For additional information, refer to Section 211-05 .

The restraint control module (RCM) is connected to the ISO 9141 communication network. The RCM controls the deployment of the air bags and safety belt pretensioners based on sensor input. For additional information, refer to Section 501-20B .

Inspection and Verification

1. Verify the customer concern by operating the system in question.

2. Visually inspect for obvious signs of electrical damage.

Visual Inspection Chart

Electrical
• Central junction box (CJB) Fuses 206 (10A) and 232 (20A) • Wiring harness • Loose or corroded connections

3. If the concern remains after the inspection, connect diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from diagnostic tool menu. If diagnostic tool does not communicate with the vehicle:
    - check that the program card is correctly installed.
    - check that the correct version of the program card is installed.
    - check the connections to the vehicle.
    - check the ignition switch position.

If the diagnostic tool still does not communicate with the vehicle, go to Pinpoint Test O.

4. Go to Pinpoint Test PC.

System Precheck

PINPOINT TEST PC: DATA LINK DIAGNOSTICS NETWORK TEST

Symptom Chart

Symptom Chart

Pinpoint Tests

⚠ CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

PINPOINT TEST A: THE ANTI-LOCK BRAKE CONTROL MODULE DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

PINPOINT TEST B: THE FRONT ELECTRONIC MODULE (FEM) DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

PINPOINT TEST C: THE RESTRAINT CONTROL MODULE (RCM) DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

PINPOINT TEST D: THE INSTRUMENT CLUSTER MODULE DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

PINPOINT TEST E: THE POWERTRAIN CONTROL MODULE (PCM) DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

PINPOINT TEST F: THE DUAL AUTOMATIC TEMPERATURE CONTROL (DATC) MODULE DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

PINPOINT TEST G: THE AUDIO CONTROL MODULE (ACM) DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

PINPOINT TEST H: THE STEERING COLUMN LOCK MODULE (SCLM) DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

PINPOINT TEST I: THE REMOTE EMERGENCY SATELLITE CELLULAR UNIT (RESCU) MODULE DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

PINPOINT TEST J: THE DRIVER SEAT MODULE (DSM) DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

PINPOINT TEST K: THE DRIVER DOOR MODULE (DDM) DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

PINPOINT TEST L: THE REAR ELECTRONIC MODULE (REM) DOES NOT RESPOND TO THE DIAGNOSTIC TOOL

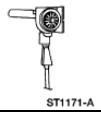
PINPOINT TEST M: NO ISO 9141 NETWORK COMMUNICATION

PINPOINT TEST N: NO SCP NETWORK COMMUNICATION

PINPOINT TEST O: NO MODULE / NETWORK COMMUNICATION NO POWER TO THE DIAGNOSTIC TOOL

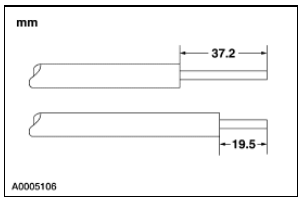
Communication Circuit Wiring Repair

Special Tool(s)

 ST1171-A	Heat Gun or equivalent 107-R0300

1. Disconnect the battery ground cable. Refer to Section 414-01 .

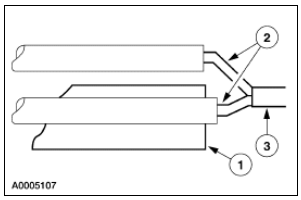
2. Strip the wires.



3. **NOTE:** Use rosin core mildly activated (RMA) solder, not acid core solder.

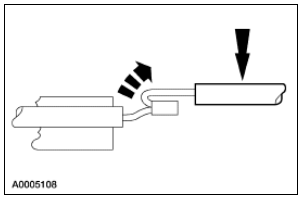
   Solder the wires.

   1. Install the heat shrink tube.
   2. Twist the wires together.
   3. Solder the wires together.

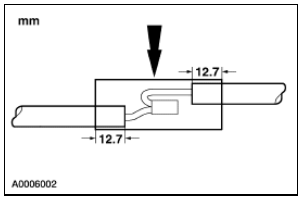


4. **NOTE:** Wait for the solder to cool before moving the wires.

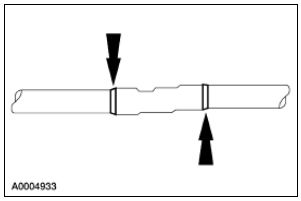
   Bend the wires back in a straight line.



5. Position the heat shrink tube over the wire repair.
   - Overlap the heat shrink tube on both wires.



6. Use Heat Gun to heat the repaired area until adhesive flows out both ends of the heat shrink tube.



7. Reconnect the battery ground cable.

Module Configuration

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224 New Generation STAR (NGS) Tester 418-F052 or equivalent diagnostic tool

Principles of Operation

Some modules must be programmed as part of the repair procedure. If this procedure is not followed the module will not function correctly and may set a number of DTCs, including B2477 or P1639, which indicate that some necessary data has not been programmed into the module.

Modules that need programming should not be exchanged between vehicles. In most cases the parameter values or settings are unique to that vehicle, and if not set correctly will cause concerns or faults.

Some programmable parameters, such as belt minder on/off, can be changed from the factory setting at the customer's request.

WDS will automatically attempt to retrieve the module configuration information from all modules, and from a backup location in the powertrain control module (PCM) when vehicle ID is carried out. If the module and the PCM do not contain correct information, the diagnostic tool will either request "As Built" data or display a list of items that you will need to manually configure. The diagnostic tool will program the module based on the data you enter.

There are three different methods that are used for module programming:

- programmable module installation (PMI)
- calibration update
- programmable parameters

Some modules do not support all three methods.

Programmable Module Installation (PMI)

The programmable module installation (PMI) method is used when a new programmable module is installed on the vehicle. It is no longer necessary to command the diagnostic tool to gather module option content from the old module. The diagnostic tool automatically obtains any available module option content information from the old module during the vehicle ID routine that runs when the diagnostic tool is initially connected to the vehicle. It is important that you connect WDS to the vehicle and allow it to identify the vehicle and obtain configuration data prior to removing any modules.

Calibration Update

Calibration update is used to install a new calibration and strategy into a module. The updates are usually issued to fix a concern in the module software and would normally be addressed by a technical service

bulletin (TSB). This method has been used by the PCM for several years. Other modules will be adopting this strategy as well.

Programmable Parameters

This method is used to configure parameters that can be modified in service. These are typically at the preference of the customer. Not all features controlled by the module are listed in this configuration method. Refer to the Module Configuration Index for a list of features by system.

If a module that has been modified using programmable parameters needs to be installed, the PMI procedure will maintain the parameters in their altered state if WDS is able to communicate with the old module during Vehicle ID. Otherwise you may need to use programmable parameters to return them to the altered state.

Vehicle Identification (VID) Block

Some PCMs contain a memory area called a vehicle identification (VID) block. The VID block is used to store backup data for each programmable module, as well as powertrain configuration information.

If the diagnostic tool cannot retrieve module option content information from the suspect module, the diagnostic tool will attempt to extract backup information from the PCM VID block.

The PCM VID block contains the factory settings for the configurable modules unless the PCM is flashed with a new calibration, in which case some PCM parameters may be modified.

As-Built Data Center

The As-Built Data Center maintains a record of the vehicle configuration in a database. The vehicle VIN is required to obtain this information. The As-Built Data Center records the applicable module configurations stored in each module before the vehicle leaves the factory. The As-Built Data Center will always reflect the original build of the vehicle as it left the factory. Only contact the As-Built Data Center when directed to do so by the diagnostic tool.

Inspection and Verification

1. Visually inspect for obvious signs of electrical damage. Refer to the following chart:

   Visual Inspection Chart

Electrical
• Wiring harness • Connectors

Configurable Modules

The vehicle contains the following modules that are configurable:

- anti-lock brake/traction control/IVD module (ABS)
- dual automatic temperature control (DATC)
- drivers door module (DDM)
- instrument cluster module (ICM)
- front electronics module (FEM)
- message center module (MCM)

- rear electronics module (REM)
- remote emergency satellite cellular unit (RESCU)
- audio control module (ACM)

Programmable Parameters Index

System	Programmable Parameter Items
Warnings and chimes	Belt minder
Security	• Two-stage unlock • Easy entry/exit • Horn chirp • Auto-locks
Message center	• Default oil life warning threshold

2002 Lincoln LS Contents/Index

-- J --

Jacking and Lifting, Section Table of Contents

Jacking

Torque Specifications

Description	Nm	lb-in
Battery ground cable	10	89

Anti-Theft Perimeter

The perimeter anti-theft system consists of:

- front door ajar switches (integral part of the latch assemblies)
- rear door ajar switches (integral part of the latch assemblies)
- underhood ajar switch
- luggage compartment ajar switch
- luggage compartment lid disarm switch
- driver door lock cylinder switch (integral part of latch assemblies)
- front electronic module (FEM)
- rear electronic module (REM)
- driver door module (DDM)
- four button remote transmitter

Anti-Theft Perimeter

Refer to Wiring Diagrams Cell 117 for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Principles of Operation

Anti-Theft Perimeter Protection Feature

The anti-theft perimeter protection feature is controlled by the front electronic module (FEM), the rear electronic module (REM), and the driver door module (DDM). The alarm can be armed using the LOCK button in the remote transmitter to the DDM, which sends a message through the Standard Corporate Protocol (SPC) communications network to the FEM; or by using the driver or passenger door lock switch if the corresponding door is open when LOCK is actuated; or by locking the vehicle with the key in the driver door lock cylinder. The FEM and REM will then monitor all features, which will activate the alarm. These are:

- all door ajar switches
- hood and luggage compartment lid ajar switches
- ignition switch

The luggage compartment key cylinder will not disarm the vehicle's perimeter alarm. The luggage compartment alarm can be temporarily inhibited through the luggage compartment lid disarm switch, located in the luggage compartment lock key cylinder. Once the luggage compartment closes, the perimeter alarm system will immediately start monitoring the luggage compartment. The perimeter alarm can only be disarmed using the remote transmitter or the driver door lock cylinder switch, or by cycling to RUN a valid programmed key in the ignition switch.

Additionally, a single security hardwire from the FEM to the REM is monitored for an open.

If any of the above features receive any activation once the alarm has been armed, the alarm will activate the visual and audible alerts.

Inspection and Verification

NOTE: If installing a new FEM, REM or DDM, the new module must be reconfigured. Refer to Section 418-01 .

1. Verify the customer concern by operating the perimeter anti-theft system.

2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Hood switch • Door disarm switch(es) • Luggage compartment lid disarm switch • Ignition switch • Vehicle horn	• Central junction box (CJB) Fuses: ♦ 205 (5A) ♦ 207 (5A) ♦ 222 (10A) • Battery junction box (BJB) Fuses: ♦ 422 (20A) ♦ 425 (40A) • FEM • REM • DDM • Connectors • Circuitry

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel. If using NGS, select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTICS TEST. If the diagnostic tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for front electronic module (FEM), go to Pinpoint Test A.
   - NO RESP/NOT EQUIP for rear electronic module (REM), go to Pinpoint Test B.
   - NO RESP/NOT EQUIP for driver door module (DDM), go to Pinpoint Test C.
   - SYSTEM PASSED, select FEM, REM from the main menu, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the FEM or REM.

6. If the DTCs retrieved are related to the concern, go to FEM Diagnostic Trouble Code (DTC) Index or REM Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

FEM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1319	Driver Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1327	Passenger Door Ajar Circuit Failure	FEM	REFER to Section 417-02 .
B1342	ECU is Defective	FEM	CLEAR the DTC. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new FEM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test.
B1438	Wiper Mode Select Switch Circuit Failure	FEM	REFER to Section 501-16 .
B1446	Wiper Park Sense Circuit Failure	FEM	REFER to Section 501-16 .
B1479	Wiper Washer Fluid Level Sensor Circuit Failure	FEM	REFER to Section 413-01 .
B1499	Lamp Turn Signal Left Circuit Failure	FEM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1503	Lamp Turn Signal Right Circuit Failure	FEM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	FEM	REFER to Section 417-01 .
B1519	Hood Switch Circuit Failure	FEM	GO to Pinpoint Test D .
B1567	Lamp Headlamp High Beam Circuit Failure	FEM	REFER to Section 417-01 .
B1676	Battery Pack Voltage Out of Range	FEM	REFER to Section 414-00 .
B1794	Lamp Headlamp Low Beam Circuit Failure	FEM	REFER to Section 417-01 .
B2214	Window Passenger Front Up Switch Short to Battery	FEM	REFER to Section 501-11 .
B2215	Window Passenger Front Down Switch Short to Battery	FEM	REFER to Section 501-11 .
B2312	Mirror Passenger Horizontal Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2316	Mirror Passenger Vertical Feedback Potentiometer Circuit Failure	FEM	REFER to Section 501-09 .
B2443	Powertrain Performance Mode Switch Circuit Failure	FEM	Not Used
B2477	Module Configuration Failure	FEM	REFER to Section 418-01 .
C1284	Oil Pressure Switch Failure	FEM	REFER to Section 413-01 .
C1446	Brake Switch Circuit Failure	FEM	REFER to Section 413-01 .
C1924	VAPS Solenoid Actuator Output Circuit Short to Ground	FEM	REFER to Section 211-00 .
C1925	VAPS Solenoid Actuator Return Circuit Failure	FEM	REFER to Section 211-00 .

U1027	SCP (J1850) Invalid or Missing Data for Engine RPM	PCM	CARRY OUT the Powertrain Control Module (PCM) self-test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the Anti-Lock Brake Control Module (ABS) self-test. REFER to Section 206-09A .
U1059	SCP (J1850) Invalid or Missing Data for Transmission / Transaxle / PRNDL	PCM	CARRY OUT the Powertrain Control Module (PCM) self-test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the Instrument Cluster (ICM) self-test. REFER to Section 413-01 .
U1222	SCP (J1850) Invalid or Missing Data for Interior Lamps	ICM	CARRY OUT the Instrument Cluster (ICM) self-test. REFER to Section 413-01 .
U1227	SCP (J1850) Invalid or Missing Data for Body Status Request	ICM	CARRY OUT the Instrument Cluster (ICM) self-test. REFER to Section 413-01 .

REM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1201	Fuel Sender Circuit Failure	REM	REFER to Section 413-01 .
B1300	Power Door Lock Circuit Failure	REM	REFER to Section 501-14B .
B1310	Power Door Unlock Circuit Failure	REM	REFER to Section 501-14B .
B1331	Decklid Ajar Rear Door Circuit Failure	REM	REFER to Section 417-02 .
B1335	Door Ajar RR Circuit Failure	REM	REFER to Section 417-02 .
B1342	ECU is Defective	REM	CLEAR the DTC. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new REM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test.
B1483	Brake Pedal Input Circuit Failure	REM	REFER to Section 417-01 .
B1499	Lamp Turn Signal Left Circuit Failure	REM	REFER to Section 417-01 .
B1501	Lamp Turn Signal Left Circuit Short to Battery	REM	REFER to Section 417-01 .
B1503	Lamp Turn Signal Right Circuit Failure	REM	REFER to Section 417-01 .
B1505	Lamp Turn Signal Right Circuit Short to Battery	REM	REFER to Section 417-01 .
B1551	Decklid Release Circuit Failure	REM	REFER to Section 501-14B .
B1571	Door Ajar LR Circuit Failure	REM	REFER to Section 417-02 .
B1676	Battery Pack Voltage Out of Range	REM	REFER to Section 414-00 .
B1984	Luggage Compartment Lid Anti-theft Disarm Circuit Short to Ground	REM	Go To Pinpoint Test K .
B2172	Inertia Switch Input Circuit Open	REM	REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.
B2174	Window Driver Rear Remote Up Switch Short to Battery	REM	REFER to Section 501-11 .

B2178	Window Driver Rear Remote Down Switch Short to Battery	REM	REFER to Section 501-11 .
B2190	Window Passenger Rear Remote Up Switch Short to Battery	REM	REFER to Section 501-11 .
B2194	Window Passenger Rear Remote Down Switch Short to Battery	REM	REFER to Section 501-11 .
B2477	Module Configuration Failure	REM	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the Anti-Lock Brake Control Module (ABS) self-test. REFER to Section 206-09A .
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/ PRNDL	PCM	CARRY OUT the Powertrain Control Module (PCM) self-test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1218	SCP (J1850) Invalid or Missing Data for External Lamps	ICM	CARRY OUT the Instrument Cluster (ICM) self-test. REFER to Section 413-01 .

DDM Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1309	Power Door Lock Circuit Short to Ground	DDM	REFER to Section 501-14B .
B1341	Power Door Unlock Circuit Short to Ground	DDM	REFER to Section 501-14B .
B1342	ECU is Defective	DDM	CLEAR the DTC. RETRIEVE the DTCs. If DTC B1342 is retrieved, INSTALL a new DDM. REFER to Section 419-10 . CLEAR the DTCs. REPEAT the self-test.
B1400	Driver Power Window One-Touch Window Relay Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1405	Driver Power Window Down Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1408	Driver Power Window Up Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1416	Power Window LR Motor Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1420	Passenger Power Window Motor Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1424	Power Window RR Motor Circuit Short to Battery	DDM	REFER to Section 501-11 .
B1530	Memory Set Switch Circuit Short to Ground	DDM	REFER to Section 501-09 .
B1534	Memory 1 Switch Circuit Short to Ground	DDM	REFER to Section 501-09 .
B1538	Memory 2 Switch Circuit Short to Ground	DDM	REFER to Section 501-09 .
B1676	Battery Pack Voltage Out of Range	DDM	REFER to Section 419-10 .
B2112	Door Driver Set Switch Stuck Failure	DDM	REFER to Section 501-14B .

B2116	Door Driver Reset Switch Stuck Failure	DDM	REFER to Section 501-14B .
B2320	Mirror Driver Horizontal Feedback Potentiometer Circuit Failure	DDM	REFER to Section 501-09 .
B2324	Mirror Driver Vertical Feedback Potentiometer Circuit Failure	DDM	REFER to Section 501-09 .
B2336	Mirror Switch Assembly Circuit Failure	DDM	REFER to Section 501-09 .
B2425	Remote Keyless Entry Out of Synchronization	DDM	REFER to Section 501-14B .
B2477	Module Configuration Failure	DDM	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS	CARRY OUT the Anti-Lock Brake Control Module (ABS) self-test. REFER to Section 206-09A .
U1059	SCP (J1850) Invalid or Missing Data for Transmission / Transaxle / PRNDL	PCM	CARRY OUT the Powertrain Control Module (PCM) self-test. REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart

Symptom Chart

Pinpoint Tests

⚠ CAUTION: Electronic modules are sensitive to electrical charges. If exposed to these charges, damage may result.

PINPOINT TEST A: NO COMMUNICATION WITH THE FRONT ELECTRONIC MODULE (FEM)

PINPOINT TEST B: NO COMMUNICATION WITH THE REAR ELECTRONIC MODULE (REM)

PINPOINT TEST C: NO COMMUNICATION WITH THE DRIVER DOOR MODULE (DDM)

PINPOINT TEST D: THE ANTI-THEFT SYSTEM DOES NOT OPERATE CORRECTLY LIGHTS FLASH FIVE TIMES WHEN ARMING THE SYSTEM

PINPOINT TEST E: THE ALARM SYSTEM DOES NOT ARM/DISARM USING THE DRIVER SET SWITCH

PINPOINT TEST F: THE ALARM SYSTEM DOES NOT ARM/DISARM USING THE REMOTE TRANSMITTER

PINPOINT TEST G: BATTERY VOLTAGE OUT OF RANGE FEM

PINPOINT TEST H: BATTERY VOLTAGE OUT OF RANGE REM

PINPOINT TEST I: BATTERY VOLTAGE OUT OF RANGE DDM

PINPOINT TEST J: THE ALARM SYSTEM DOES NOT OPERATE CORRECTLY ALARM DOES NOT ACTIVATE WITH HOOD AJAR/OPEN

PINPOINT TEST K: THE ALARM SYSTEM DOES NOT OPERATE CORRECTLY LUGGAGE COMPARTMENT LID DISARM SWITCH

Switch Front Door Ajar

Removal and Installation

NOTE: The front door ajar switch is an integral part of the door latch assembly.

For additional information, refer to Section 501-14A .

Switch Rear Door Ajar

Removal and Installation

NOTE: The rear door ajar switch is an integral part of the door latch assembly.

For additional information, refer to Section 501-14A .

Torque Specifications

Description	Nm	lb-in
Battery ground cable	10	89

Anti-Theft Passive Anti-Theft System (PATS)

The passive anti-theft system (PATS) contains the following components:

- theft indicator
- encoded ignition key
- transceiver module
- instrument cluster
- powertrain control module (PCM)
- standard corporate protocol (SCP) communication network
- starter relay

The PATS uses radio frequency identification technology to deter a driveaway theft. Passive means that it does not require any activity from the user. This system is known as SecuriLock® in North America, Safeguard® in the U.K. and PATS in continental Europe. This information can be found in customer literature such as the Owner's Literature.

The PATS uses a specially encoded ignition key. Each encoded ignition key contains a permanently installed electronic device called a transponder. Each transponder contains a unique electronic identification code, with over 10 billion billion combinations.

Each encoded ignition key must be programmed into the vehicle instrument cluster before it can be used to start the engine. There are special diagnostic procedures outlined in the manual that must be carried out if the encoded ignition keys need to be replaced.

The encoded key is larger than a traditional ignition key. The key does not require batteries and should last the life of the vehicle.

The transceiver module communicates with the encoded ignition key. The transceiver contains an antenna connected to a small electronics module and is located behind the instrument panel attached to the ignition lock casting. During each vehicle start sequence, the transceiver module reads the encoded ignition key identification code and sends the data to the instrument cluster.

The control functions are contained in the instrument cluster. This module carries out all of the PATS functions such as receiving the identification code from the encoded ignition key and controlling the engine enable. The instrument cluster initiates the key interrogation sequence when the key is inserted into the vehicle ignition switch and also when the vehicle ignition switch is turned to RUN or START.

The PATS uses the PCM to enable or disable the engine. The instrument cluster communicates with the PCM over the SCP communication network in order to enable engine operation. The instrument cluster and the PCM use sophisticated messages in order to prevent a theft. The instrument cluster and the PCM share security data when first installed together that makes them a matched pair. After this security data sharing, these modules will not function in other vehicles. The shared PCM ID is remembered even if the battery is disconnected. The instrument cluster also stores the vehicle key identification code even if the battery is disconnected. There are special diagnostic procedures outlined in this workshop manual that may be carried out if either the instrument cluster or the PCM needs replacement.

All elements of PATS must be functional before the engine is allowed to start. If any of the components are not working correctly, the vehicle will not start.

PATS uses a visual theft indicator. This indicator will prove out for three seconds when the ignition switch is turned to RUN or START under normal operation. If there is a PATS problem, this indicator will either flash rapidly or glow steadily (for more than three seconds) when the ignition switch is turned to RUN or START.

PATS differs from perimeter anti-theft systems in that PATS enables and disables the engine from starting. If equipped, the perimeter anti-theft system protects the perimeter of the vehicle (doors, hood and trunk) and sounds an alarm.

PATS also disables the starter motor in addition to the PCM disabling the engine. When PATS disables the vehicle, it will neither crank nor start. If the instrument cluster is removed from the vehicle, the engine will not crank.

The starter relay is used as an additional means of disabling the vehicle engine. The starter relay is disabled when the PATS cannot read a valid encoded ignition key at ignition ON. The PATS will not store a diagnostic trouble code (DTC) or flash the theft indicator if a valid encoded ignition key is read but a fault occurs in the starter relay circuit.

The PATS is not compatible with aftermarket remote start system, which allow the vehicle to be started from outside the vehicle. These systems may reduce the vehicle security level, and also may cause no-start issues. Remote start systems must be removed before investigation of PATS-related no start issues.

Anti-Theft Passive Anti-Theft System (PATS)

Refer to Wiring Diagrams Cell 112 , for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Inspection and Verification

NOTE: The instrument cluster must be reconfigured after replacement. Refer to Section 418-01 .

1. Verify the customer concern by operating the system.

2. Visually inspect for obvious signs of mechanical and electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Large metallic objects, devices such as electronic debit transponders or a second ignition key on the same key ring as the PATS ignition key • Ignition lock cylinder • Encoded ignition key (PATS key) • Use of non-encoded ignition key (key without the molded plastic head, non-PATS key) • Use of a non-programmed encoded ignition key	• Central junction box (CJB) Fuse 224 (5A) • Instrument cluster • PATS transceiver module • Connectors • Ignition switch

3. If the concern remains after the inspection, connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:
   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

4. If diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

5. Carry out the DATA LINK DIAGNOSTICS. If diagnostic tool responds with:
   - CKT914, CKT915 or CKT70 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
   - NO RESP/NOT EQUIP for instrument cluster module (ICM), go to Pinpoint Test A.
   - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), erase the continuous DTCs and carry out self-test diagnostics for the ICM.

6. If the DTCs retrieved are related to the concern, go to Instrument Cluster Diagnostic Trouble Code (DTC) Index to continue diagnostics.

7. If no DTCs related to the concern are retrieved, proceed to Symptom Chart to continue diagnostics.

Instrument Cluster Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1201	Fuel Sender Circuit Failure	ICM	REFER to Section 413-01 .
B1205	EIC Switch-1 Assembly Circuit Failure	ICM	REFER to Section 413-01 .
B1209	EIC Switch-2 Assembly Circuit Failure	ICM	REFER to Section 413-01 .
B1213	Anti-Theft Number of Programmed Keys Is Below Minimum	ICM	GO to Pinpoint Test D .
B1246	Dim Panel Potentiometer Switch Circuit Failure	ICM	REFER to Section 413-00 .
B1342	ECU Is Defective	ICM	CLEAR the DTCs. Carry out the instrument cluster self-test. If DTC B1342 is retrieved again, INSTALL a new instrument cluster. REFER to Section 413-01 .
B1352	Ignition Key-In Circuit Failure	ICM	REFER to Section 211-05 .
B1470	Lamp Headlamp Input Circuit Failure	ICM	REFER to Section 417-01 .
B1567	Lamp Headlamp High Beam Circuit Failure	ICM	REFER to Section 417-01 .
B1600	PATS Ignition Key Transponder Signal Is Not Received	ICM	GO to Pinpoint Test G .
B1601	PATS Received Incorrect Key-Code From Ignition Key Transponder	ICM	GO to Pinpoint Test H .
B1602	PATS Received Invalid Format of Key-Code From Ignition Key Transponder	ICM	GO to Pinpoint Test I .
B1676	Battery Pack Voltage Out of Range	ICM	REFER to Section 413-01 .
B1681	PATS Transceiver Module Signal Is Not Received	ICM	GO to Pinpoint Test J .
B1689	Autolamp Delay Circuit Failure	ICM	REFER to Section 417-01 .
B1875	Turn Signal / Hazard Switch Signal Circuit Failure	ICM	REFER to Section 417-01 .
B2103	Antenna Not Connected	ICM	GO to Pinpoint Test K .

B2139	Data Mismatch (Receive Data Does Not Match What Was Expected)	ICM	GO to Pinpoint Test E .
B2141	NVM Configuration Failure	ICM	GO to Pinpoint Test F .
B2143	NVM Memory Failure	ICM	REFER to Section 413-01 .
B2162	Data Mismatch #2 (receive data does not match what was expected)	ICM	GO to Pinpoint Test E .
B2328	Column Reach Feedback Potentiometer Circuit Failure	ICM	REFER to Section 211-04 .
B2332	Column Tilt Feedback Potentiometer Circuit Failure	ICM	REFER to Section 211-04 .
B2351	Steering Column Switch Circuit Failure	ICM	REFER to Section 211-04 .
B2431	Transponder Programming Failed	ICM	GO to Pinpoint Test G .
B2472	Fog Lamp Switch Failure	ICM	REFER to Section 417-01 .
B2477	Module Configuration Failure	ICM	REFER to Section 418-01 .
U1041	SCP (J1850) Invalid or Missing Data for Vehicle Speed	ABS, ABS/TC, IVD	CARRY OUT the ABS, ABS/TC, or IVD self-test.
U1059	SCP (J1850) Invalid or Missing Data for Transmission/Transaxle/ PRNDL	PCM	CARRY OUT the PCM self-test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1073	SCP (J1850) Invalid or Missing Data for Engine Coolant Fluid Temperature	PCM	CARRY OUT the PCM self-test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.
U1123	SCP (J1850) Invalid or Missing Data for Odometer Rolling Count	ABS, ABS/TC, IVD	CARRY OUT the ABS, ABS/TC, IVD self-test.
U1147	SCP (J1850) Invalid or Missing Data for Vehicle Security	PCM	CARRY OUT the PCM self-test. REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: NO COMMUNICATION WITH THE MODULE INSTRUMENT CLUSTER

PINPOINT TEST B: THE ANTI-THEFT INDICATOR IS ALWAYS/NEVER ON NO THREE SECOND THEFT INDICATOR PROVE OUT

PINPOINT TEST C: THE ALARM SYSTEM DOES NOT OPERATE CORRECTLY THE VEHICLE STARTS BUT FLASHES RAPIDLY AT KEY ON

PINPOINT TEST D: ANTI-THEFT NUMBER OF PROGRAMMED KEYS IS BELOW MINIMUM

PINPOINT TEST E: DATA MISMATCH (RECEIVE DATA DOES NOT MATCH WHAT WAS EXPECTED)

PINPOINT TEST F: THE ANTI-THEFT SYSTEM DOES NOT OPERATE CORRECTLY NVM CONFIGURATION FAILURE (NO PCM ID EXCHANGED BETWEEN INSTRUMENT CLUSTER AND PCM)

PINPOINT TEST G: THE ANTI-THEFT SYSTEM DOES NOT OPERATE CORRECTLY PATS IGNITION KEY TRANSPONDER SIGNAL IS NOT RECEIVED OR TRANSPONDER PROGRAMMING FAILED (DAMAGED KEY OR NON-PATS KEY)

PINPOINT TEST H: THE ANTI-THEFT SYSTEM DOES NOT OPERATE CORRECTLY PATS RECEIVED INCORRECT KEY-CODE FROM IGNITION KEY TRANSPONDER (UNPROGRAMMED ENCODED IGNITION KEY)

PINPOINT TEST I: THE ANTI-THEFT SYSTEM DOES NOT OPERATE CORRECTLY PATS RECEIVED INVALID FORMAT OF KEY-CODE FROM IGNITION KEY TRANSPONDER (PARTIAL KEY READ)

PINPOINT TEST J: THE ANTI-THEFT SYSTEM DOES NOT OPERATE CORRECTLY PATS TRANSCEIVER SIGNAL IS NOT RECEIVED (NOT CONNECTED, DAMAGED, OR WIRING)

PINPOINT TEST K: THE ANTI-THEFT SYSTEM DOES NOT OPERATE CORRECTLY ANTENNA NOT CONNECTED OR DEFECTIVE TRANSCEIVER

PINPOINT TEST L: THE VEHICLE DOES NOT START THEFT INDICATOR DOES NOT PROVES OUT AND FLASHES RAPIDLY

Security Access Procedure

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent

NOTE: The security access procedure is utilized to obtain passive anti-theft system (PATS) security access. PATS security access must be granted to erase ignition keys, enable/disable the spare key programming switch or carry out parameter resets for the instrument cluster. The security access procedure invokes an inherent 10 minute time delay prior to granting security access during which time the diagnostic tool must remain connected to the vehicle. Once security access has been granted, a security access command menu is displayed that offers various command options.

NOTE: Select only the commands required by the appropriate pinpoint test.

1. Using the Ford Service Function (FSF) card, select the appropriate instrument cluster. Enter SECURITY ACCESS PROCEDURE. This procedure will take 10 minutes to carry out, during which time the the ignition switch must be in RUN and the diagnostic tool must be connected to the vehicle.

2. After the 10-minute security access procedure has been completed, a new menu will be displayed with command options. Select only those functions required before exiting out of this menu. Once exited out of this menu, the security access procedure must be carried out again to select additional commands.

Key Programming Program a Key Using Two Programmed Keys

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

NOTE: This procedure only works if two or more programmed ignition keys are available and it is desired to program additional key(s). If two keys are not available, follow the procedure in Key Programming Erase All Key Codes and Program Two Keys .

NOTE: The PID SPARE_KY must be enabled for this procedure to operate. If this Parameter Identification (PID) is not enabled, follow the security access procedure and select Spare Key Programming Switch: Enabled. Refer to Key Programming Enable/Disable Spare Key Programming .

NOTE: If the programming procedure is successful, the new key(s) will start the vehicle and the THEFT INDICATOR will illuminate for approximately three seconds.

NOTE: If the programming procedure is not successful, the new key(s) will not start the vehicle and the THEFT INDICATOR will flash. If the programming procedure was not successful, repeat the key programming procedure from Step 1. If the failure repeats, check hot at all times in instrument cluster for correct battery voltage. Repair the circuit if voltage is not present. For additional information, refer to Diagnosis and Testing to review diagnostic trouble codes (DTCs) and carry out pinpoint tests as required.

NOTE: A maximum of eight ignition keys can be programmed to a passive anti-theft system (PATS) equipped vehicle. Use INSTRUMENT CLUSTER PID NUMKEYS to determine how many keys are programmed to the vehicle.

NOTE: If the steps are not carried out as outlined, the programming procedure will end.

NOTE: Ignition keys must have correct mechanical key cut for the vehicle and must be a PATS encoded key.

1. Insert the first programmed ignition key into the ignition lock cylinder and turn the ignition switch from OFF to RUN (maintain the ignition switch in RUN for one second).

2. Turn the ignition switch to OFF and remove the first key from the ignition lock cylinder.

3. Within five seconds of turning the ignition switch to OFF, insert the second programmed ignition key into the ignition lock cylinder and turn the ignition switch from OFF to RUN (maintain the ignition switch in RUN for one second).

4. Within five seconds of turning the ignition switch to RUN, turn the ignition switch to OFF and remove the second key from the ignition lock cylinder.

5. Within 10 seconds of turning the ignition lock cylinder to OFF, insert the unprogrammed ignition key (new key) into the ignition lock cylinder and turn the ignition switch from OFF to RUN (maintain the ignition switch in RUN for one second).

6. If it is desired to program additional key(s), repeat the key programming procedure from the beginning.

Key Programming Erase All Key Codes and Program Two Keys

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

NOTE: This procedure is used when a customer needs keys programmed into the system and does not have two programmed ignition keys available. This procedure is also useful when programmed ignition key(s) have been lost or a new ignition switch assembly has been installed, and it is desired to erase key(s) from the passive anti-theft system (PATS) memory.

NOTE: This procedure will erase all programmed ignition keys from the vehicle memory and the vehicle will not start until two keys have been reprogrammed to the vehicle.

NOTE: Two PATS encoded keys with the correct mechanical cut must be available to carry out this procedure. One or both of them may be the customer's original keys.

NOTE: If additional (more than two) keys are to be programmed, refer to Key Programming Program a Key Using Two Programmed Keys. If the remaining keys are with the customer and are not available with the vehicle, then instruct the customer to refer to the owner's literature under the "Programming Spare [SecuriLock ® (North America), Safeguard ® (U.K.) or PATS for all other markets] Keys Procedure" for instructions on programming the remaining keys.

1. Turn the ignition switch from OFF to RUN.

2. Connect the diagnostic tool. Follow the SECURITY ACCESS PROCEDURE for instrument cluster to obtain security access.

3. From diagnostic tool menu, select IGNITION KEY CODE ERASE.

4. **NOTE:** DO NOT select any additional commands from this menu.

   Turn the ignition switch to OFF and disconnect diagnostic tool.

5. Insert the first encoded ignition key into the ignition lock cylinder and turn the switch to RUN for three seconds.

6. Insert the second encoded ignition key into the ignition lock cylinder and turn the switch to RUN for three seconds.

7. The vehicle should now start with both ignition keys.

Key Programming Enable/Disable Spare Key Programming

Special Tool(s)

 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

NOTE: The spare key programming switch is a diagnostic tool programmable switch that provides the capability to enable/disable the spare key programming procedure. The spare key programming procedure can be found in the owner's literature and also in this section under Key Programming Program a Key Using Two Programmed Keys . This programmable switch is provided as a convenience for rental company fleets or other fleet purchasers who may not want the spare key programming procedure available to the vehicle driver.

NOTE: The spare key programming switch state can be viewed by the instrument cluster PID SPARE_KY found on the Diagnostic Card.

1. Insert a programmed ignition key into the ignition lock cylinder and turn the ignition switch to RUN.

2. Enter diagnostic tool. Follow the SECURITY ACCESS PROCEDURE. For additional information, refer to Security Access Procedure to obtain security access.

3. **NOTE:** The default setting on delivery of all new vehicles is <ENABLE>.

   From diagnostic tool menu, select SPARE KEY PROGRAMMING SWITCH selection to the desired setting:
   <ENABLE> Spare key programming procedure is accessible.
   <DISABLE> Spare key programming procedure is not accessible.

Key Programming Additional Key With One Programmed Key

NOTE: This procedure is used when a customer needs to have an additional key programmed into the vehicle without erasing stored key codes, but does not have two programmed keys available. This procedure is also useful when attempting to determine if an ignition key is defective, as a new key can be installed without erasing keys or without having two programmed keys available.

NOTE: Before programming, the new key must have the correct mechanical cut for the ignition lock.

NOTE: If eight keys are already programmed, this procedure will not allow any further ignition keys to be programmed without erasing all stored key codes first. The number of keys programmed into the system can be determined using the INSTRUMENT CLUSTER PID NUMKEYS.

1. Turn the ignition switch from the OFF position to the RUN position using the new, unprogrammed ignition key.

2. Enter diagnostic tool using the Ford Service Function (FSF) card and enter the appropriate instrument cluster. Follow Security Access to obtain security access. For additional information, refer to Security Access Procedure .

3. From the diagnostic tool menu Select: IGNITION KEY CODE PROGRAM.

4. Turn the ignition switch to the OFF position and disconnect diagnostic tool.

5. Attempt to start the engine with the new ignition key. The vehicle engine should start and run normally.

Module Passive Anti-Theft Transceiver

Removal and Installation

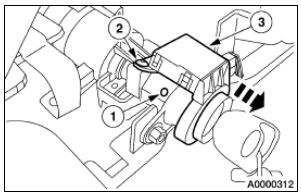
1. ⚠ **CAUTION: Electronic modules are sensitive to electrical charges. If exposed to these charges, damage may result.**

   Disconnect the battery ground cable. Refer to Section 414-01 .

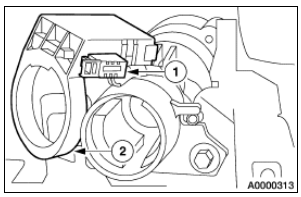
2. Remove the instrument panel cluster finish panel. Refer to Section 501-12 .

3. Position the passive anti-theft system (PATS) transceiver module aside.
   1. **NOTE:** The ignition must be turned to the RUN position to remove ignition lock cylinder.

      Push the tab and remove the ignition lock cylinder.
   2. Remove the screw.
   3. Position the PATS transceiver module aside.

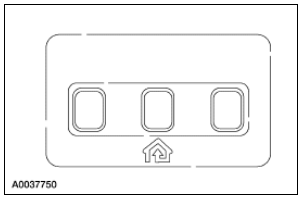


4. Remove the PATS transceiver module.
   1. Disconnect the electrical connector.
   2. Remove the PATS transceiver module.



5. To install, reverse the removal procedure.

Universal Transmitter



The HomeLink® universal transmitter provides a convenient way to substitute up to three hand-held transmitters with a single built-in device. The universal transmitter:

- will operate garage doors, gates and home/office lighting and security systems.
- will actually learn and transmit the radio frequency of up to three hand-held transmitters from any of the systems mentioned above.
- is an integral part of the left sun visor assembly and is powered by the vehicle battery and charging system.

Universal Transmitter

Inspection and Verification

1. Verify the customer concern by operating the system.
2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection Chart

Mechanical
• Damaged universal transmitter • Damaged receiver

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the fault is not visually evident, verify the symptom and refer to the Symptom Chart.

Symptom Chart

Symptom Chart

Pinpoint Tests

PINPOINT TEST A: THE UNIVERSAL TRANSMITTER IS INOPERATIVE

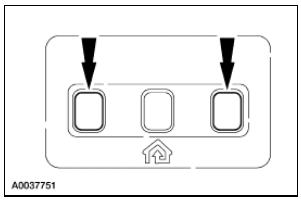
Programming

⚠ WARNING: A garage door opening system that cannot stop or reverse itself after detecting an object in its path does not meet current federal safety standards. To decrease the risk of serious injury or death, do not use this HomeLink® transmitter with a door opening system that lacks stop and reverse features as required by federal standards. This includes any garage door opening system manufactured before April 1, 1982. For more information, call HomeLink® customer assistance at 1-800-355-3515.

1. **⚠ CAUTION: During this procedure, the system that you are programming will be made to operate. Make sure that people or objects are clear of the garage door or gate being programmed.**

   Verify the hand-held transmitter is operative.

2. Prepare for programming the universal transmitter by erasing all three channels by holding down the two outside buttons until the red light begins to flash (20-30 seconds). Release both buttons.

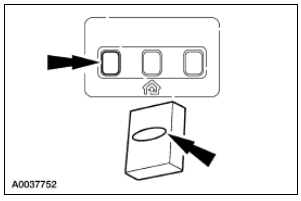


3. Select one of the three universal transmitter channels to be programmed by pressing the desired button.

4. Hold the end of the hand-held transmitter 25-51mm (1-2 in) from the front surface of the universal transmitter so that the red light can still be seen.

5. **NOTE:** During programming, the hand-held transmitter may automatically stop transmitting after two seconds, which may not be long enough to program the universal transmitter. If programming this type of hand-held transmitter, continue to hold the button on the universal transmitter while re-pressing the hand-held transmitter button every two seconds (Canada only).

   Use both hands to press the hand-held transmitter button and the desired button on the universal transmitter. Do not release either button.



6. Hold down both buttons until the red light on the universal transmitter flashes, first slowly and then rapidly. Release both buttons when the rapid flashing begins. The universal transmitter has successfully learned the new frequency signal and can be used in place of the hand-held transmitter(s).

7. **NOTE:** If the hand-held transmitter appears to program the universal transmitter but does not open

the garage door, the garage door opener may have a "code protected" or "rolling code" feature.

To operate, simply press the appropriate button on the universal transmitter. The red light is on while the signal is being transmitted.

Training a Garage Door Opener Equipped With "Rolling Codes"

8. Program the hand-held transmitter to the universal transmitter. For additional information, refer to Programming in this section.

9. Train the garage door opener receiver to recognize the universal transmitter.
    1. Remove the cover panel from the garage door opener receiver.
    2. Locate the training button on the garage door opener receiver. Location and color of the button may vary by garage door opener manufacturer. Refer to the garage door opener instruction manual or call HomeLink® customer assistance at 1-800-355-3515.
    3. Press the training button on the garage door opener receiver for 1-2 seconds.
    4. Press the programmed universal transmitter button for as long as the universal transmitter red light flashes (1-2 seconds). Release the button and re-press the button to confirm that the universal transmitter is trained to the receiver.
    5. The garage door opener should recognize the universal transmitter.

Erasing Channels

1. **NOTE:** Individual channels cannot be erased, but can be reprogrammed using the procedures for programming; for additional information, refer to Programming in this section.

    To erase all three programmed channels, hold down the two outside buttons until the red light begins to flash (20-30 seconds). Release both buttons.

Torque Specifications

Description	Nm	lb-in
Telematics control module nuts	9	80

General Specifications

Item	Specification
Ultra-Clear Spray Glass Cleaner E4AZ-19C507-AA	ESR-M14P5-A

Telematics

The telematics system consists of the following:

- global positioning sensor (GPS) antenna
- telematics control switch assembly
- telematics control module
- cellular phone handset
- handset battery
- handset holder
- steering column shroud mounted microphone
- steering wheel switch controls
- portable support electronics (PSE) module
- glass mounted cellular phone antenna
- antenna cable
- audio unit controls
- audio unit
- restraint control module (RCM)

The telematics system allows a user to request emergency assistance (police, ambulance, fire, wrecker) or roadside assistance. Also, if any of the vehicle's air bags are deployed while the telematics control module is powered ON, the system automatically issues a call for emergency assistance.

The portable cellular phone system has two operating modes: hands-free and portable. Hands-free operation mode allows phone operation without picking up the phone. It uses the vehicle audio system speakers to emit sound and the steering column shroud mounted microphone to speak into. Portable operation mode allows phone usage while it is disconnected from the handset holder. The phone is powered up by its battery when used as a portable.

Telematics

Refer to Wiring Diagrams Cell 136 for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent
 ST2332-A	Worldwide Diagnostic System (WDS) 418-F224, New Generation STAR (NGS) Tester 418-F052, or equivalent diagnostic tool

Principles of Operation

System Description

The telematics control module controls the system. It is wired to the vehicle's cellular phone system, audio unit, restraint control module (RCM), audio unit display, telematics control switch, and global positioning sensor (GPS) antenna. The telematics system uses the cellular phone system to place calls to the Lincoln Security Response Center. It mutes the audio unit upon placing a call and returns volume to the audio unit when the call is ended. It monitors an input from the RCM to determine if an air bag has deployed and it provides the user with visual feedback during an activation by displaying status messages on the audio unit display.

The telematics control switch provides the user with two buttons (assistance and information) for activating the system. The assistance button is used to place a call for emergency assistance and the information button is used to place a call for roadside assistance.

The GPS antenna receives data from a group of GPS satellites and is used by the telematics system to determine the location of the vehicle when one of the activation buttons is pressed or an air bag is deployed.

Powering Up

The telematics system powers up when the ignition switch is turned to RUN. During power up, the telematics control module carries out a check of the system. The system check takes about 15 seconds. If a failure is detected, the telematics control module displays VCS FAULT on the audio unit display for two seconds.

If the cellular phone is not detected, the telematics control module displays VCS FAULT on the audio unit display for two seconds, followed by PHONE ABSENT and VCS OFF. Each of these messages are displayed on the audio unit display for two seconds.

Pressing Assistance, Pressing Information, and Air bag Deployment

When the telematics control switch assistance or information button is pressed, or one of the air bags is deployed, the telematics system tries to take control of the cellular phone system and inform the user that an activation is in progress by displaying CALLING SOS /INFO on the audio unit display. The telematics

system also mutes the audio unit and displays PHONE on the audio unit display.

If the cellular phone is connected, but the telematics control module determines that the phone is not telematics compatible, WRONG PHONE is displayed on the audio unit display.

Upon determining that the cellular phone is connected and communication with it can be established, the telematics control module checks cellular service availability (signal is sensed by the vehicle's cellular phone).

If service is not available, the telematics control module continues to check for service for up to two minutes. During this time, NO SIGNAL followed by RETRYING are continually displayed in rotation on the audio unit display. If service is still not available after two minutes, CALL FAILED is displayed on the audio unit display and the activation is terminated.

If service is available, the telematics system places a data call to the Lincoln Security Response Center central computer.

If the call has trouble going through because the cellular system is busy, the telematics system continues trying to place the call for up to one minute. During this time, SYSTEM BUSY followed by PLEASE WAIT are continuously displayed in rotation on the audio unit display, and then the activation is terminated.

Once the data call is answered by the response center, the telematics system sends it an electronic data message. This message includes: the type of activation (assistance, information, or air bag), a customer identification number (CID), the most recently recorded location (latitude and longitude), the speed and direction of travel of the vehicle, the time at which the location and speed data was taken, and the system's cellular phone number.

After the data is received by the response center, DATA RECEIVED is displayed on the audio unit display. The call is displayed on the audio unit display. The call is then forwarded to the response center's operator switchboard.

If the data call fails to go through, the telematics system carries out a voice call redial to the Lincoln Security Response Center operator switchboard. While this call is being placed, REDIAL is displayed on the audio unit display. While the system is waiting for an operator to answer, PLEASE WAIT is displayed on the audio unit display.

Upon answering the call, the operator attempts to talk with the caller to determine the level of assistance required. The operator contacts the appropriate emergency assistance provider if the call was made due to a telematics control switch assistance button press or an air bag deployment. If the call was caused by pressing the telematics control switch information button, the operator provides directions to the location asked for by the caller.

Throughout the rest of the call ID... CT..., and LN... data that was sent to the response center are continually displayed in rotation on the audio unit display.

If the call is initiated by pressing the console emergency message assistance button or by the deployment of an air bag, the caller has no control of the phone and all communication with the response center operator occurs hands-free. If the call is initiated by pressing the telematics control switch information button, communication with the response center operator defaults to hands-free but may be switched to private mode (using the phone's internal speaker and microphone) by removing the phone from its cradle.

When the telematics call is ended, the audio unit will return to the normal display and the audio unit will return to the previous operating mode.

Powering Down

When the ignition switch is turned from RUN to OFF, or from RUN to ACC, the telematics system may be powered off so no status messages will be displayed. After the call is ended, the telematics system remains on for ten minutes and fifteen seconds. After the ten minutes and fifteen seconds have expired, the telematics system will power OFF. To reuse the telematics system after this time, the ignition switch has to be turned back to the RUN position or the phone has to be turned on.

Inspection and Verification

1. **NOTE:** The telematics control module must be reconfigured upon installation. For additional information, refer to Section 418-01 .

   NOTE: The cellular phone module is also referred to as the portable support electronics (PSE) module.

   NOTE: When installation of a new cellular phone is necessary, contact an authorized Ford cellular phone repair facility.

   Verify the customer concern by operating telematics system and the portable cellular phone both in portable mode and while connected to the vehicle. Observe the information and message center display while operating telematics.

2. Visually inspect for obvious signs of electrical damage.

3. Make sure the portable cellular phone is turned on. With the power button ON, the system should be on while the ignition switch is in ACC or RUN.

4. Make sure the customer is calling within the coverage area. NO SERVICE will appear in the display if the customer is calling from outside the coverage area.

5. Check to see if the Roam indicator is on. If so, refer to the roaming instructions in the cellular phone literature.

6. Check to see if the display reads Locked. If so, press Clr and enter the customer unlock code.

7. Make sure the portable cellular phone is securely seated in the holder.

8. Check the handset holder connections in the console.

9. Check the portable cellular phone antenna and cellular phone module connections.

10. Check the portable cellular phone system registration. Also, check to make sure that the portable cellular phone is correctly programmed. Incorrect programming can result in single system scanning, loss of speed dialing, loss of hands-free audio, loss of auto redial, loss of dial tone multi-frequency tones, and the loss of other keypad/portable cellular phone functions. For additional information, refer to the cellular phone literature.

11. Check the customer account status with the cellular carrier.

If the customer concern is still present, follow these steps to diagnose the concern:

12. Inspect to determine if one of the following mechanical or electrical concerns apply:

Visual Inspection Chart

Electrical
• Central junction box (CJB) fuses: ♦ 4 (10A) ♦ 15 (10A) ♦ 38 (10A) • portable cellular phone • microphone • circuitry • telematics control switch • telematics control module • GPS antenna coaxial cable and connectors • portable support electronics (PSE) module • portable cellular phone holder • glass-mounted cellular phone antenna

13. If the inspection reveals obvious concerns which can be readily identified, repair as necessary.

14. If the cause of the fault is not visually evident, proceed to diagnose the portable cellular phone system by:

- connecting the Diagnostic Tool or
- entering the audio unit self-diagnostic mode.

Diagnostic Tool

15. Connect the diagnostic tool to the data link connector (DLC) located beneath the instrument panel and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:

- check that the program card is correctly installed.
- check the connections to the vehicle.
- check the ignition switch position.

16. **NOTE:** The audio unit must be in AM, FM1 or FM2 mode to enter the diagnostic tool.

    If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool manual.

17. Carry out the DATA LINK DIAGNOSTIC TEST. If the diagnostic tool responds with:
    - CKT70, CKT915, or CKT915 = ALL ECUS NO RESP/NOT EQUIP, refer to Section 418-00 .
    - NO RESP/NOT EQUIP for the telematics control module, Go To Pinpoint Test A .
    - NO RESP/NOT EQUIP for audio unit, refer to Section 415-00 .
    - SYSTEM PASSED, retrieve and record the continuous diagnostic trouble codes (DTCs), clear the continuous DTCs and carry out self-test diagnostics for the telematics control

module and the PSE module.

18. If the DTCs retrieved are related to the concern, go to the telematics Control Module or Audio Unit Diagnostic Trouble Code (DTC) Index.

19. If no DTCs related to the concern are retrieved, proceed to the Symptom Chart.

Telematics Control Module Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
B1216	Emergency and Road Side Assistance Switch Circuit Short to Ground	Telematics Control Module	Go To Pinpoint Test F .
B1342	ECU is Defective	Telematics Control Module	CLEAR existing DTCs. RETRIEVE new DTCs. If DTC B1342 is retrieved, INSTALL a new telematics control module. REFER to Telematics Control Module in this section. CLEAR the DTCs. REPEAT the self-test.
C1943	Air Bag Deployment Indication Input Fault	Telematics Control Module	Go To Pinpoint Test G .
B1874	Cellular Phone Handset Not Communicating	Telematics Control Module	Go To Pinpoint Test H .
B1893	GPS Antenna Open Circuit	Telematics Control Module	Go To Pinpoint Test I .
B2102	GPS Antenna Circuit Short to Ground	Telematics Control Module	Go To Pinpoint Test J .
B2141	NVM Configuration Failure #1	Telematics Control Module	CLEAR the DTCs. CARRY OUT telematics control module On-Demand Self-Test. If DTC B2141 is retrieved, INSTALL a new telematics control module. REFER to Telematics Control Module in this section. CLEAR the DTCs. REPEAT the self-test.
B2477	Module Configuration Failure	Telematics Control Module	CHECK the telematics control module configuration. REFER to Section 418-01 .

Audio Unit Diagnostic Trouble Code (DTC) Index

DTC	Description	Source	Action
U2008	Audio Phone is Not Responding	Audio Unit	Go To Pinpoint Test B .

Note: For a complete master list of all audio unit DTCs, refer to Section 415-00 .

Audio Unit Self-Diagnostic Mode

NOTE: To enter the speaker walk-around test or audio unit self-diagnostic mode, the audio unit must be turned on and in audio unit tuner mode (AM/FM).

Audio unit self-diagnostic mode can only be entered while in the speaker walk-around test.

1. To enter the speaker walk-around test, press the audio unit preset buttons 3 and 6 simultaneously.

2. The speaker walk-around test stops at each speaker and applies a tone to each speaker for approximately 1-2 seconds. Each speaker is tested and displayed on the audio unit in the following sequence: SPEAKER RF, SPEAKER LF, SPEAKER LR, SPEAKER RR, SUBWOOFER I (for subwoofer, if equipped), and SUBWOOFER II (for center imaging speakers, if equipped). This test can isolate an open circuit for each speaker (broken wire or disconnect). However, a short circuit can only be isolated to either the RH pair or LH pair.

3. The speaker walk-around test automatically continues and tests for:

- a speaker circuit short. If a short is present, SPKR SHORT is displayed. Speaker circuit shorts are detected only in the RF, LF, LR, and RR speaker circuitry.
- the CD/DJ. The audio unit display will show NO DJ if not present. The speaker walk-around test ends and the audio unit returns to its previous setting.

4. Audio unit self-diagnostic mode has six tests available:

- Preset button 1 = Audio internal/external SELF TEST. If SELF FAIL is displayed, press TUNE > to scroll view the DTCs stored. Refer to the Audio Unit Diagnostic Trouble Codes (DTC) Index. If the system is OK, SELF PASS is displayed.
- Preset button 2 = View/Clear continuous diagnostic trouble codes (DTCs). NO DTCS is displayed if no DTCs are retrieved. If DTCS FOUND is displayed, press TUNE > button to view the DTCs retrieved. Refer to the Audio Unit Diagnostic Trouble Codes (DTC) Index. To clear all DTCs, press the EJECT button. DTCS CLEAR will be displayed.
- Preset button 3 = SIGNAL TEST. This test measures the average strength at the current tuner setting.
- Preset button 4 = Software configuration level. This test queries each audio unit system controller for the software configuration level. SOFT LEVELS will be displayed upon completion of the query. Press TUNE > to scroll view the software configuration version level.

Controller	Description	Audio unit Display Example
Main	Main Micro Software Version	MAIN ##.##.##
CDSP	CDSP Micro Software Version	CDSP ##.##.##
ADSP	ADSP Micro Software Version	ADSP ##.##.##
Auxiliary	Auxiliary Software Version	AUX ##.##.##
CD/DJ	CDDJ Software Version	DJ ##.##.##
CD Changer	CDR Software Version	CD ##.##.##
Tape Deck	Tape Deck Software Version	TAP ##.##.##
RSC	Rear Seat Controller Software Version	RCP ##.##.##

- Preset button 5 = DISPLAY TEST. This test will light all the audio unit display segments for five seconds, then turn all segments off. When the test is complete, DISPLAY TEST is displayed on the bezel.
- Preset button 6 = Configuration/EQ ID. This test queries the audio system controller for the software configuration and EQ ID.

5. To enter these tests, press the preset button desired while in the speaker walk-around test. This will abort the speaker walk-around test and start the selected test.

6. To exit audio unit self-diagnostic mode, turn the ignition switch or the audio unit off.

7. If the concern remains and the fault is not detected, proceed to the Diagnostic Tool to continue diagnostics.

System/Carrier Concerns

Dropped calls, bad connections, noisy audio and other intermittent symptoms usually indicate a system or cellular carrier concern, and are not the fault of the phone itself. Such symptoms may occur in situations such as the following:

- in certain geographic areas (for example: areas of excessive foliage or hills) or at the edge of coverage areas
- at the same place each day
- at the same time each day
- under bridges, in tunnels, lower freeways, or congested downtown areas

If the cellular phone exhibits any of the above symptoms or symptoms occur under the above conditions, the customer or the dealer should contact customer assistance at their particular cellular provider/carrier or call the assistance number provided in the Ford cellular system dealer kit.

Other Possible Concerns

1. If, for some reason, the customer's electronic serial number was incorrectly recorded in the carrier switch, the phone will not work. Call the number in your dealer kit to check the electronic serial number.

2. The customer's initial call must be made in his/her home coverage area for correct activation of the Ford cellular system.

3. The customer may have to wait 24 hours after the coverage activation before making a call from outside of his/her home coverage area or the phone might be reported stolen and coverage stopped.

4. There may be a slight delay in activation after leaving the dealership.

If, after checking these possibilities, the phone still does not function, do not attempt to repair the phone. Call the cellular distributor or Ford Cellular Technical Assistance Center.

Symptom Chart

Symptom Chart

Pinpoint Tests

⚠ CAUTION: Be careful when probing the battery junction box (BJB), central junction box (CJB), or any connectors. Damage will result to the connector receptacle if the probe or terminal being used is too large.

⚠ CAUTION: Electronic modules are sensitive to static electrical discharges. If exposed to these charges, damage may result.

NOTE: The cellular phone module (CPM) is also referred to as the portable support electronics (PSE) module.

PINPOINT TEST A: NO COMMUNICATION WITH THE TELEMATICS CONTROL MODULE

PINPOINT TEST B: DTC U2008 AUDIO PHONE IS NOT RESPONDING

PINPOINT TEST C: THE TELEMATICS SYSTEM DOES NOT OPERATE CORRECTLY TELEMATICS DOES NOT RESPOND TO THE TELEMATICS CONTROL SWITCH

PINPOINT TEST D: THE TELEMATICS SYSTEM DOES NOT OPERATE CORRECTLY TELEMATICS/CELLULAR PHONE INTERFACE IS INOPERATIVE

PINPOINT TEST E: THE TELEMATICS SYSTEM DOES NOT OPERATE CORRECTLY THE AIR BAG WARNING INDICATOR IS ON CONTINUOUSLY

PINPOINT TEST F: DTC B1216 TELEMATICS CONTROL SWITCH CIRCUIT SHORT TO GROUND

PINPOINT TEST G: DTC C1943 AIR BAG DEPLOYMENT INDICATION INPUT FAULT

PINPOINT TEST H: DTC B1874 CELLULAR PHONE HANDSET NOT COMMUNICATING

PINPOINT TEST I: DTC B1893 GLOBAL POSITIONING SYSTEM (GPS) ANTENNA OPEN CIRCUIT

PINPOINT TEST J: DTC B2102 GLOBAL POSITIONING SYSTEM (GPS) ANTENNA CIRCUIT SHORT TO GROUND

PINPOINT TEST K: THE PHONE DOES NOT POWER UP

PINPOINT TEST L: THE PHONE INFORMATION IS NOT DISPLAYED

PINPOINT TEST M: REDUCED SOUND OR NO SOUND THROUGH THE SPEAKERS

PINPOINT TEST N: THE PHONE WILL NOT GO INTO HANDS-FREE MODE

PINPOINT TEST O: NO RESPONSE TO PRESSING THE PHONE BUTTON

PINPOINT TEST P: POOR RECEPTION, STATIC ON CALLS, FREQUENT DROP OF CALLS

PINPOINT TEST Q: NO SERVICE DISPLAY STAYS ON

PINPOINT TEST R: CANNOT ENTER THE PROGRAMMING MODE

PINPOINT TEST S: THE CELLULAR PHONE MICROPHONE IS NOT OPERATING CORRECTLY

PINPOINT TEST T: THE VOICE ACTIVATED PHONE FUNCTIONS ARE INOPERATIVE

PINPOINT TEST U: THE HANDSET BATTERY DOES NOT CHARGE

Telematics Control Module

Removal and Installation

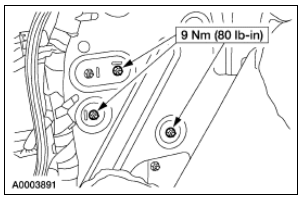
1. ⚠ **CAUTION: Electronic modules are sensitive to electrical charges. If exposed to these charges, damage may result.**

   NOTE: The telematics control module must be reconfigured upon installation. Refer to Section 418-01 .

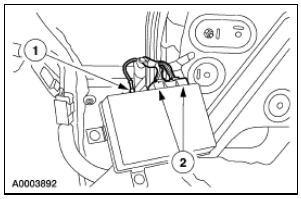
   Disconnect the battery ground cable. For additional information, refer to Section 414-01 .

2. Position the LH quarter trim panel aside.

3. Remove the telematics control module nuts.



4. Remove the telematics control module.
   1. Disconnect the antenna.
   2. Disconnect the electrical connector.

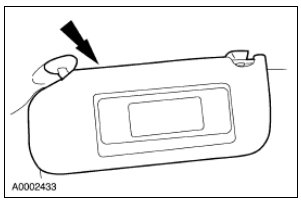


5. To install, reverse the removal procedure.

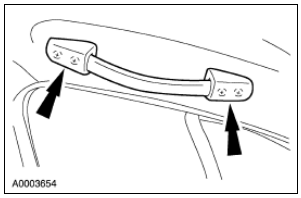
Telematics Control Switch

Removal and Installation

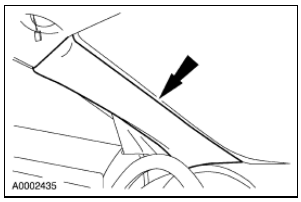
1. Remove the sun visors from each side.



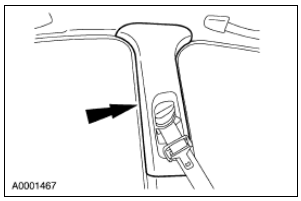
2. Remove the assist handle.



3. Remove the windshield garnish mouldings.



4. Remove the upper B-pillar trim.

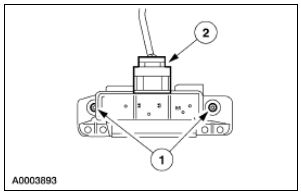


5. Remove the front dome lamp assembly bezel.

6. **NOTE:** Folding the headliner will require installing a new headliner.

   Carefully pull the front of the headliner down to gain access to the telematics control switch.

7. Remove the telematics control switch.
   1. Remove the screws.
   2. Disconnect the electrical connector.

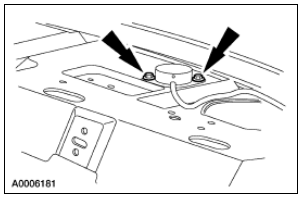


8. To install, reverse the removal procedure.

Global Positioning System (GPS) Antenna

Removal and Installation

1. Remove the package tray trim panel. For additional information, refer to Section 501-05 .
2. Remove the two bolts and the global positioning sensor (GPS) antenna.



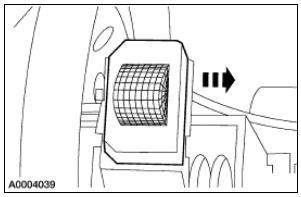
3. To install, reverse the removal procedure.

Microphone

Removal and Installation

1. Remove the air bag sliding contact. For additional information, refer to Section 501-20B .

2. Remove the cellular phone microphone from the air bag sliding contact.

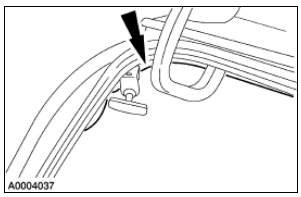


3. To install, reverse the removal procedure.

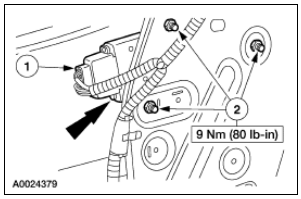
Portable Support Electronics (PSE) Module

Removal and Installation

1. Open the luggage compartment and position the LH trim near the rear seat release handle aside.



2. Remove the portable support electronics (PSE) module.
    1. Disconnect the electrical connector.
    2. Remove the nuts.



3. To install, reverse the removal procedure.

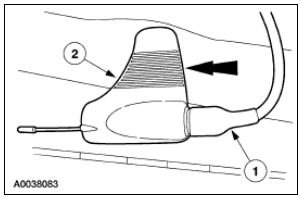
Cellular Phone Antenna

Removal and Installation

1. ⚠ **CAUTION: To avoid damage to the glass, do not pry the antenna base when removing.**

   Remove the cellular phone antenna base.

   1. Disconnect the antenna cable.
   2. Cut the two-way tape holding the cellular phone antenna base to the glass.



2. **NOTE:** Before applying new two-way tape to install the cellular phone antenna base, use Ultra-Clear Spray Glass Cleaner E4AZ-19C507-AA meeting Ford specification ESR-M14P5-A or equivalent to thoroughly clean the glass.

   NOTE: Inside and outside antenna bases must be carefully and accurately aligned so they do not cover any heater wire grids.

   NOTE: The coaxial cable connector must be installed toward the right of the vehicle.

   To install, reverse the removal procedure.

Torque Specifications

Description	Nm	lb-in
Battery ground cable	10	89
Rear electronic module (REM) nuts	7	62
Front electronic module (FEM) bolt	9	80
Front electronic module (FEM) nuts	4	35
Auxiliary junction block nuts	3	27

Module Controlled Functions

The multifunction modules consist of the:

- front electronic module (FEM)
- rear electronic module (REM)
- driver door module (DDM)
- driver seat module (DSM)

Multifunction Electronic Module

For warning chime concerns,

Refer to Wiring Diagrams Cell 66 for schematic and connector information.

For exterior lighting concerns,

Refer to Wiring Diagrams Cell 85 for schematic and connector information.

For interior lighting concerns,

Refer to Wiring Diagrams Cell 89 for schematic and connector information.

For perimeter anti-theft concerns,

Refer to Wiring Diagrams Cell 117 for schematic and connector information.

For power mirror concerns,

Refer to Wiring Diagrams Cell 124 for schematic and connector information.

For power seat concerns,

Refer to Wiring Diagrams Cell 120 for schematic and connector information.

For power window concerns,

Refer to Wiring Diagrams Cell 100 for schematic and connector information.

For remote keyless entry and power door lock concerns,

Refer to Wiring Diagrams Cell 111 for schematic and connector information.

For daytime running lamp concerns,

Refer to Wiring Diagrams Cell 42 for schematic and connector information.

For variable assist power steering (VAPS) concerns,

Refer to Wiring Diagrams Cell 128 for schematic and connector information.

For roof opening panel concerns,

Refer to Wiring Diagrams Cell 101 for schematic and connector information.

Module Driver Door (DDM)

Removal and Installation

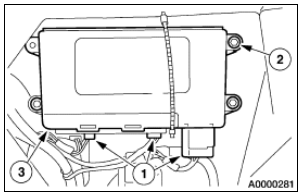
1. **⚠ CAUTION: Prior to removal of the module, it is necessary to upload module configuration information to the appropriate diagnostic equipment. This information needs to be downloaded into the new module once installed. For additional information, refer to Section 418-01 .**

   ⚠ CAUTION: Electronic modules are sensitive to electrical charges. If exposed to these charges, damages may result.

   Disconnect the battery ground cable. Refer to Section 414-01 .

2. Remove the driver door trim panel. For additional information, refer to Section 501-05 .

3. Remove the driver door module.
   1. Disconnect the electrical connectors.
   2. Remove the three bolts.
   3. Remove the DDM.



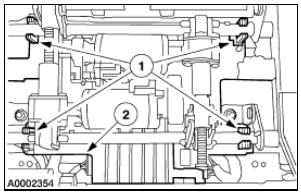
4. To install, reverse the removal procedure.

Module Driver Seat (DSM)

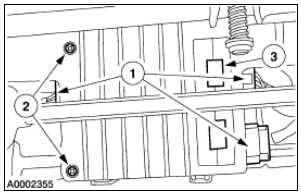
Removal and Installation

1. Remove the driver seat; refer to Section 501-10 .

2. Release the driver seat module (DSM) bracket from the seat track.
    1. Release the four retainers.
    2. Release the module bracket.



3. Remove the DSM.
    1. Disconnect the electrical connectors.
    2. Remove the screws.
    3. Remove the DSM.



4. **NOTE:** Once the new module is installed, it is necessary to calibrate the seat. For additional information, refer to Section 501-10 .

   NOTE: It is important to make sure that the locking tabs are in the correct locations.

   To install, reverse the removal procedure.

Module Rear Electronic (REM)

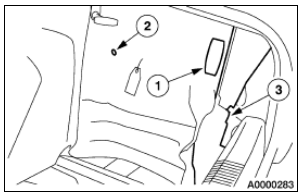
Removal and Installation

1. **⚠ CAUTION: Prior to removal of the module, it is necessary to upload module configuration information to the appropriate diagnostic equipment. This information needs to be downloaded into the new module once installed. For additional information, refer to Section 418-01 .**

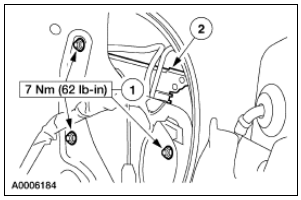
   ⚠ CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

   Disconnect the battery ground cable. Refer to Section 414-01 .

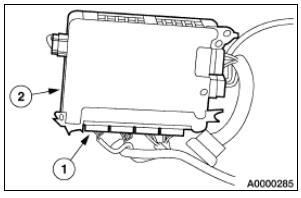
2. Position the RR quarter trim panel aside.
   1. Disconnect the luggage compartment lamp.
   2. Remove the push clip.
   3. Position RR quarter trim panel aside.



3. Position the rear electronic module (REM) aside.
   1. Remove the nuts.
   2. Position the REM aside.



4. Remove the REM.
   1. Disconnect the seven electrical connectors.
   2. Remove the REM.



5. To install, reverse the removal procedure.

Module Front Electronic (FEM)

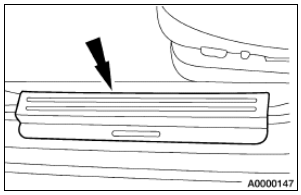
Removal and Installation

1. **⚠ CAUTION: Prior to removal of the module, it is necessary to upload module configuration information to the appropriate diagnostic equipment. This information needs to be downloaded into the new module once installed. For additional information, refer to Section 418-01 .**

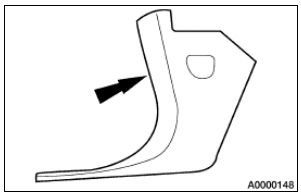
   ⚠ CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

   Disconnect the battery ground cable. Refer to Section 414-01 .

2. Remove the LH scuff plate.



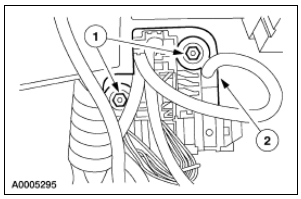
3. Release the retaining clips and remove the LH A-pillar lower trim panel.



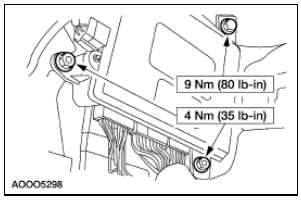
4. Remove the lower instrument panel finish panel.
   - Remove the courtesy lamp from the instrument panel finish panel.

5. Position the driver side carpet aside.

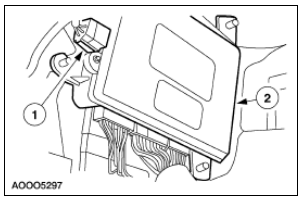
6. Position interior auxiliary junction box (AJB) aside.
   1. Remove the nuts.
   2. Position the AJB aside.



7. Remove the nuts, bolt and position the FEM aside.



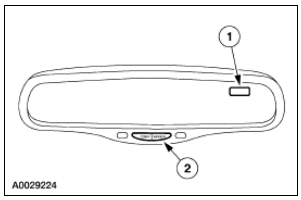
8. Remove the FEM.
    1. Disconnect the six electrical connectors.
    2. Remove the FEM.



9. To install, reverse the removal procedure.

Electronic Compass

Compass Display



Item	Part Number	Description
1		Compass display
2		COMP/MIRROR switch

NOTE: The compass display and module are integral to the inside rear view mirror and not installed separately. For additional information, refer to Section 501-09 .

The compass:

- has a two-character display in the upper RH side of the mirror, which indicates the direction in which the vehicle is pointed (N, NE, E, SE, S, SW, W, NW).
- uses an electronic compass sensor that is attached to the mirror to windshield bracket.
- has compass adjustment (calibration and zone variation) controlled by a COMP switch on the mirror.

Electronic Compass

Refer to Wiring Diagrams Cell 125 for schematic and connector information.

Special Tool(s)

 ST1137-A	73III Automotive Meter 105-R0057 or equivalent

Inspection and Verification

NOTE: Press the COMP button to turn on the display.

1. Verify the customer concern by operating the vehicle along roads of known direction to duplicate the customer concern with the compass.

2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection Chart

Mechanical	Electrical
• Mirror assembly	• Central junction box (CJB) fuse 216 (5A) • Circuitry • Loose or corroded connectors • Compass sensor (part of the inside rear view mirror)

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. If the fault is not visually evident, determine the symptom and proceed to the Symptom Chart.

Symptom Chart

Symptom Chart

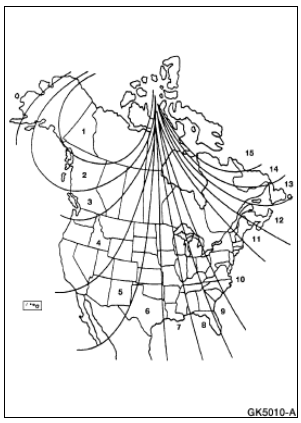
Pinpoint Tests

PINPOINT TEST A: THE COMPASS IS INOPERATIVE

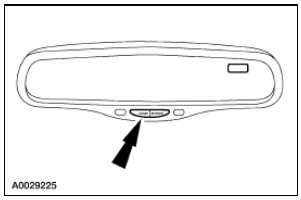
PINPOINT TEST B: THE COMPASS IS INACCURATE

Compass Zone Adjustment

1. Refer to the compass calibration zone map to select the correct compass zone setting for your geographical location.



2. With the compass display turned on, press and hold the COMP button (for three seconds) until the display shows the current zone of operation.



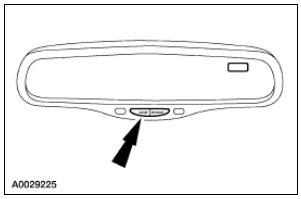
3. Momentarily press the COMP button to cycle the zone number display. Set the zone display number to match the vehicle location on the compass calibration zone map.

4. Releasing the switch for 10 seconds will exit the zone setting mode.

Compass Calibration

1. **NOTE:** For optimum calibration, drive to an open, level location away from large metallic objects or structures. Switch off all non-essential electrical accessories (rear window defrost, heater, A/C, map lamps and wipers) and make sure all doors are shut.

   Press and hold the COMP button until C appears (six seconds). Release the COMP button.



2. Drive the vehicle at less than 8 km/h (5 mph) in a continuous circle until the compass heading is shown.

3. If the C message does not turn off within five circles, demagnetize the vehicle. Refer to Vehicle Demagnetizing in this section.

Vehicle Demagnetizing

⚠ CAUTION: During demagnetizing, the demagnetizer coil will be pulled toward the vehicle. Place a cloth over the vehicle roof to protect the vehicle surface if contact occurs. Make sure the cloth covers the front third and the entire width of the roof.

NOTE: The demagnetizing process requires the use of a demagnetizing coil commonly used by television repair technicians to demagnetize television tubes.

NOTE: To demagnetize, use a constant circular motion over the vehicle roof. Do not turn off the demagnetizer while sweeping the vehicle roof to prevent remagnetizing ferrous materials contained in the vehicle.

NOTE: During the demagnetizing process, make sure the phenolic surface of the tool (the side opposite the handle) is closest to the vehicle surface.

NOTE: Turn the ignition switch to the OFF position.

1. Demagnetize the front third of the vehicle roof.
    1. Turn on the demagnetizer at least 1 meter (3 ft) away from the vehicle.
    2. Holding the demagnetizer no more than 2.5 cm (1 in) from the roof and starting on the passenger side, demagnetize the front third of the roof closest to the windshield using a constant circular motion. Keep the circle's radius within 30 cm (12 in) while sweeping across the entire surface of the roof closest to the windshield. Continue the circular motion four times.
    3. After the fourth pass and without stopping, move the demagnetizer at least 1 meter (3 ft) away from the vehicle.
    4. Turn the demagnetizer off.
2. **NOTE:** The demagnetizer must be located over the outside of the windshield no greater than 2.5 cm (1 in).

   Demagnetize the inside rear view mirror mounting pad.

    1. Turn on the demagnetizer at least 1 meter (3 ft) away from the vehicle.
    2. Using a circular motion, pass the demagnetizer over the outside of the windshield near the inside rear view mirror mounting pad. Without stopping, move the demagnetizer at least 1 meter (3 ft) away from the vehicle.
    3. Turn the demagnetizer off.
3. Carry out the compass zone adjustment procedure; refer to Compass Zone Adjustment in this section.
4. Carry out the calibration adjustment procedure; refer to Compass Calibration in this section.

2002 Lincoln LS Contents/Index

-- K --

Key Programming - Additional Key With One Programmed Key

Key Programming - Enable/Disable Spare Key Programming

Key Programming - Erase All Key Codes and Program Two Keys

Key Programming - Program a Key Using Two Programmed Keys

Keyless Entry

DESC & OPER: Keyless Entry/Computer Operated Locks

DIAG & TEST: Keyless Entry/Computer Operated Locks

Keyless Entry/Computer Operated Locks, Section Table of Contents

Knock Sensor (KS) - 3.0L

Knock Sensor (KS) - 3.9L

2002 Lincoln LS
Contents/Index

-- L --

Lamp Assembly - Fog Lamp

Lamp Assembly - Front Map

Lamp Assembly - Headlamp

Lamp Assembly - High Mounted Stoplamp

Lamp Assembly - Rear Reading

Lamp Assembly - Rear

Lamp Assembly - Stoplamp

Lamp Switch - Brake Pedal Position (BPP)

Lamp Switch - Headlamp

Latch Remote Control - Fuel Door Release

Latch - Front Door

Latch - Rear Door

Lead Terminal Repair

Leakage Inspection

License Plate Housing

License Plate Lamp

Lifting

Lock Cylinder - Door

Locks, Latches And Mechanisms

Lower Arm

REM & INST: Front Suspension

REM & INST: Rear Suspension

Lower Intake Manifold

Lumbar Control Switch

-- M --

Main Control Valve Body
DISASSEM & ASSEM OF SUBASSEM: Automatic Transmission - 5R55N

IN-VEH REP: Automatic Transmission - 5R55N

Manifold Gauge Set Connection

Manual Transaxle/Transmission and Clutch - General Information, Section Table of Contents

Manual Transaxle/Transmission, Section Table of Contents

Manual Transmission and Clutch

DESC & OPER: Manual Transaxle/Transmission and Clutch - General Information

DIAG & TEST: Manual Transaxle/Transmission and Clutch - General Information

Manual Transmission

DESC & OPER: Manual Transaxle/Transmission

DIAG & TEST: Manual Transaxle/Transmission

Mass Air Flow (MAF) Sensor

Microphone

Mirror - Exterior Rear View

Mirror - Glass

Mirror - Interior Rear View

Mirror - Motor

Module Communications Network, Section Table of Contents

Module Configuration

DIAG & TEST: Module Configuration

Section Table of Contents

Module Controlled Functions

Module - Driver Door (DDM)

Module - Driver Seat (DSM)

Module - Front Electronic (FEM)

Module - Isolator

Module - Passive Anti-Theft Transceiver

Module - Rain Sensor

Module - Rear Electronic (REM)

Module - Roof Opening Panel Control

Motor and Window Regulator - Front Door

Motor and Window Regulator - Rear Door

Motor - Front Seat Lumbar

Motor - Roof Opening Panel Assembly

Mounting Arm and Pivot Shaft

Muffler

Multifunction Electronic Control Modules, Section Table of Contents

Multifunction Electronic Module

Multifunction Switch

2002 Lincoln LS
Contents/Index

-- N --

Noise, Vibration And Harshness (NVH)
DESC & OPER: Noise, Vibration and Harshness

DIAG & TEST: Noise, Vibration and Harshness

Noise, Vibration and Harshness, Section Table of Contents

2002 Lincoln LS
Contents/Index

-- O --

Oil Cooler
IN-VEH REP: Engine 3.0L (4V)

IN-VEH REP: Engine 3.9L

Oil Filter Adapter

IN-VEH REP: Engine 3.0L (4V)

IN-VEH REP: Engine 3.9L

Oil Level Indicator and Tube

IN-VEH REP: Engine 3.0L (4V)

IN-VEH REP: Engine 3.9L

Oil Pan

IN-VEH REP: Engine 3.0L (4V)

IN-VEH REP: Engine 3.9L

Oil Pressure Switch Oil Cooler

Oil Pump Screen and Pickup Tube

Oil Pump

IN-VEH REP: Engine 3.0L (4V)

IN-VEH REP: Engine 3.9L

Opening Shield Roof Opening Panel

Output Shaft Ring Gear and Hub Shaft Assembly

Output State Control (OSC) Mode

Overdrive Brake and Coast Clutch Drum Assembly

Overdrive Planetary and One-Way Clutch Assembly

Overdrive Planetary Gears

-- P --

Panel - Roof Opening Assembly

Park System

Parking Brake and Actuation, Section Table of Contents

Parking Brake Cable - Front

Parking Brake Cable - Rear

Parking Brake Control

Parking Brake

DESC & OPER: Parking Brake and Actuation

DIAG & TEST: Parking Brake and Actuation

Parking, Rear and License Lamps

Passenger Air Bag Module

Photocell and Amplifier - Light Sensor

Pinpoint Tests - Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

Pinpoint Tests - OSC Equipped Vehicles

Piston Inspection

Piston - Diameter

Piston - Pin Diameter

Piston - Pin to Bore Diameter

Piston - Ring-to-Groove Clearance

Piston - Ring End Gap

Piston - Selection

Piston - to Cylinder Bore Clearance

Piston

Pivot Arm

Plenum Chamber

Portable Support Electronics (PSE) Module

Positive Crankcase Ventilation (PCV) Hose - 3.0L

Positive Crankcase Ventilation (PCV) Valve - 3.0L

Power Brake Actuation, Section Table of Contents

Power Brake System

Power Steering Control Valve Actuator

Power Steering Fluid Cooler

Power Steering Fluid Reservoir

Power Steering Pressure (PSP) Switch - 3.0L

Power Steering Pressure (PSP) Switch - 3.9L

Power Steering Pump Pulley - 3.0L

Power Steering Pump Pulley - 3.9L

Power Steering Pump to Steering Gear Pressure Line

Power Steering Pump - 3.0L

Power Steering Pump - 3.9L

Power Steering System Filling

Power Steering System Flushing

Power Steering System Purging

Power Steering

DESC & OPER: Power Steering

DIAG & TEST: Power Steering

Section Table of Contents

Powertrain Control Module (PCM)

Powertrain/Drivetrain Mount Neutralizing

Preliminary Inspection

Pressure Relief

Programming - Remote Keyless Entry Transmitter

Programming

Pump Auxiliary Coolant Flow, 3.9L

2002 Lincoln LS Contents/Index

-- R --

Radiator Grille Opening Panel

Radiator Grille

Range Selection

Rear Disc Brake

DESC & OPER: Rear Disc Brake

DIAG & TEST: Rear Disc Brake

Section Table of Contents

Rear Drive Axle and Differential

DESC & OPER: Rear Drive Axle/Differential

DIAG & TEST: Rear Drive Axle/Differential

Rear Drive Axle/Differential, Section Table of Contents

Rear Drive Halfshafts

DESC & OPER: Rear Drive Halfshafts

DIAG & TEST: Rear Drive Halfshafts

Section Table of Contents

Rear Footwell Duct

Rear Suspension

DESC & OPER: Rear Suspension

DIAG & TEST: Rear Suspension

Section Table of Contents

Rear Toe Adjustment

Rear View Mirrors

DESC & OPER: Rear View Mirrors

DIAG & TEST: Rear View Mirrors

Section Table of Contents

Rear Wheel Speed Sensor

REM & INST: Anti-Lock Control - Traction Control and Stability Assist

REM & INST: Anti-Lock Control - Traction Control

REM & INST: Anti-Lock Control

Receiver Drier Manifold and Tube Assembly - 3.0L

Receiver Drier Manifold and Tube Assembly - 3.9L

Receiver Drier

Refrigerant Identification Testing

Refrigerant Oil Adding

Refrigerant System Filtering After A/C Component Replacement

Release Hub and Bearing Check

Remote Convenience, Section Table of Contents

Replacement of the Weld Nut and Reinforcement

Restraints Control Module (RCM)

Retractor - Rear Center Safety Belt

Retractor - Rear LH and RH Safety Belt

Reverse Brake Drum

Reverse Servo Assembly

DISASSEM & ASSEM OF SUBASSEM: Automatic Transmission - 5R55N

IN-VEH REP: Automatic Transmission - 5R55N

Reversing Lamp

Reversing Lamps

Roof Opening Panel

DESC & OPER: Roof Opening Panel

DIAG & TEST: Roof Opening Panel

Section Table of Contents

2002 Lincoln LS Contents/Index

-- S --

Safety Belt Buckle - Front

Safety Belt Buckle - Rear

Safety Belt Cleaning

Safety Belt Maintenance

Safety Belt Pretensioner Disposal - Deployed

Safety Belt Pretensioner Disposal - Undeployed, Inoperative

Safety Belt Pretensioner Disposal - Undeployed, Scrapped Vehicle

Safety Belt Procedure After a Collision

Safety Belt Retractor and Pretensioner

Safety Belt Shoulder Height Adjuster With Stripped Weld Nuts

Safety Belt System

DESC & OPER: Safety Belt System

DIAG & TEST: Safety Belt System

Section Table of Contents

Safety Belt Tongue Rotated on Belt

Safety Precautions

Seal - Input Shaft

Seal - Output Shaft

Seal - Selector Shaft

Seals, Rings and Gaskets Locator

Seat Backrest - Rear Side Bolsters

Seat Control Switch

Seat Track

Seat - Front Cushion Side Shield

Seat - Rear Cushion

Seat - Rear Seatback

Seating, Section Table of Contents

Seats

DESC & OPER: Seating

DIAG & TEST: Seating

Secondary Air Pump - 3.0L

Secondary Air Valve - 3.0L

Secondary Air Valve - Tube, 3.0L

Security Access - Procedure

Selector Lever

Shift Patterns

Shock Absorber and Spring Assembly

DISASSEM & ASSEM: Front Suspension

DISASSEM & ASSEM: Rear Suspension

REM & INST: Front Suspension

REM & INST: Rear Suspension

Side Air Bag Module

Side Impact Sensor

Slave Cylinder

Solenoid Body Assembly

Spark Plug

Spark Plugs

Speaker - Door Mounted

Speakers

DESC & OPER: Speakers

Section Table of Contents

Special Testing Procedures

SPECIFICATIONS

Acceleration Control

Accessory Drive

Air Conditioning

Air Distribution and Filtering

Antenna

Anti-Lock Control - Traction Control and Stability Assist

Anti-Lock Control - Traction Control

Anti-Lock Control

Anti-Theft - PATS

Anti-Theft - Perimeter

Audio Unit

Automatic Transaxle/Transmission External Controls

Automatic Transmission - 5R55N

Battery, Mounting and Cables

Body Closures

Body System - General Information

Brake System - General Information

Bumpers

Charging System - General Information

Climate Control System - General Information

Clutch Controls

Clutch

Driveline System - General Information

Driveshaft

Electronic Engine Controls

Engine Cooling

Engine Emission Control

Engine Ignition - 3.0L (4V)

Engine Ignition - 3.9L

Engine System - General Information

Engine - 3.0L (4V)

Engine - 3.9L

Evaporative Emissions

Exhaust System

Exterior Lighting

Front Disc Brake

Front End Body Panels

Front Suspension

Fuel Charging and Controls - 3.0L (4V)

Fuel Charging and Controls - 3.9L

Fuel System - General Information

Fuel Tank and Lines

Generator and Regulator

Glass, Frames and Mechanisms

Handles, Locks, Latches and Mechanisms

Heating and Ventilation

Horn

Hydraulic Brake Actuation

Instrument Cluster

Instrument Panel and Console

Intake Air Distribution and Filtering

Interior Trim and Ornamentation

Manual Transaxle/Transmission and Clutch - General Information

Manual Transaxle/Transmission

Module Communications Network

Multifunction Electronic Control Modules

Parking Brake and Actuation

Power Brake Actuation

Power Steering

Rear Disc Brake

Rear Drive Axle/Differential

Rear Drive Halfshafts

Rear Suspension

Rear View Mirrors

Roof Opening Panel

Safety Belt System

Seating

Starting System

Steering Column Switches

Steering Column

Steering System - General Information

Supplemental Restraint System

Suspension System - General Information

Telematics

Transaxle/Transmission Cooling

Uni-Body, Subframe and Mounting System

Vehicle Speed Control

Wheels and Tires

Wipers and Washers

Speed Control Actuator

Speed Control Cable

Spring Lock Coupling

Sprockets

Stabilizer Bar Bushing

REM & INST: Front Suspension

REM & INST: Rear Suspension

Stabilizer Bar Link

REM & INST: Front Suspension

REM & INST: Rear Suspension

Stabilizer Bar

REM & INST: Front Suspension

REM & INST: Rear Suspension

Starter Drive and Flywheel Ring Gear Inspection

Starter Motor - 3.0L

Starter Motor - 3.9L

Starting System

DESC & OPER: Starting System

DIAG & TEST: Starting System

Section Table of Contents

Steering Column Lock Actuator - Manual Transmission

Steering Column Lock Module Parameter Reset

Steering Column Shaft - Intermediate

Steering Column Switches

DESC & OPER: Steering Column Switches

DIAG & TEST: Steering Column Switches

Section Table of Contents

Steering Column - Tilt/Telescopic Motors

Steering Column

DESC & OPER: Steering Column

DIAG & TEST: Steering Column

REM & INST: Steering Column

Section Table of Contents

Steering Gear

DISASSEM & ASSEM: Power Steering

REM & INST: Power Steering

Steering System General Information, Section Table of Contents

Steering System

DESC & OPER: Steering System General Information

DIAG & TEST: Steering System General Information

Steering Wheel Rotation Sensor

Steering Wheel

Stoplamps

Stub Shaft Pilot Bearing and Seal

Subframe Rear

Subwoofer Amplifier

Subwoofer Speaker

Sunload Sensor

Supplemental Restraint System (SRS) Deactivation and Reactivation

GEN PROC: Safety Belt System

GEN PROC: Seating

GEN PROC: Steering Column

GEN PROC: Supplemental Restraint System

Supplemental Restraint System, Section Table of Contents

Support Insulator

Suspension System - General Information, Section Table of Contents

Suspension System

Switch - Deactivator

Switch - Exterior Rear View Mirror Control

Switch - Front Door Ajar

Switch - Fuel and Luggage Compartment Lid Release

Switch - Luggage Compartment Lid Lockout

Switch - Master Window Regulator Control

Switch - Message Center

Switch - Panel Dimmer

Switch - Rear Door Ajar

Switch - Roof Opening Panel

Switch - Speed Control Actuator

2002 Lincoln LS Contents/Index
GROUP 00: Service Information

SECTION 100-01:
Identification Codes

DESCRIPTION AND OPERATION
Identification Codes
Vehicle Certification (VC) Label

2002 Lincoln LS Contents/Index
GROUP 00: Service Information

SECTION 100-02:
Jacking and Lifting

DESCRIPTION AND OPERATION
Jacking

Lifting

Lifting Points Drive-On Hoist

Lifting Points Frame Contact Lift, Single-Post Lift, Two-Post Lift

SECTION 100-04:
Noise, Vibration and Harshness

DESCRIPTION AND OPERATION
Noise, Vibration And Harshness (NVH)
Acceptable Noise, Vibration and Harshness

Diagnostic Theory

Glossary of Terms

Tools and Techniques

DIAGNOSIS AND TESTING

Noise, Vibration And Harshness (NVH)

1: Customer Interview

2: Pre-Drive Check

3: Preparing for the Road Test

4: Verify the Customer Concern

5: Road Test

6: Check OASIS/TSBs/Repair History

7: Diagnostic Procedure

NVH Condition and Symptom Categories

Symptom Charts

Pinpoint Tests

Component Tests

GENERAL PROCEDURES

Brake Disc Machining

Powertrain/Drivetrain Mount Neutralizing

Exhaust System Neutralizing

Wheel Bearing Check

2002 Lincoln LS Contents/Index

GROUP 01: Body

SECTION 501-00:
Body System General Information

SPECIFICATIONS

DESCRIPTION AND OPERATION

Body

Body and Sheet Metal

Insulation

Body Sealer Types And Applications

DIAGNOSIS AND TESTING

Body System

Inspection and Verification

Symptom Chart

2002 Lincoln LS Contents/Index
GROUP 01: Body

SECTION 501-02:
Front End Body Panels

SPECIFICATIONS

DESCRIPTION AND OPERATION

Front End Body Panels

REMOVAL AND INSTALLATION

Cowl Vent Screen

Fender

Radiator Grille Opening Panel

2002 Lincoln LS Contents/Index
GROUP 01: Body

SECTION 501-03:
Body Closures

SPECIFICATIONS

GENERAL PROCEDURES

Torsion Bar Loading

REMOVAL AND INSTALLATION

Door

Door Check Strap

2002 Lincoln LS Contents/Index
GROUP 01: Body

SECTION 501-05:
Interior Trim and Ornamentation

SPECIFICATIONS

DESCRIPTION AND OPERATION

Interior Trim

REMOVAL AND INSTALLATION

Trim Panel - Front Door

Trim Panel - Rear Door

Trim Panel - A-Pillar Lower

Trim Panel - Package Tray

Trim Panel - Upper B-Pillar

Trim Panel - Quarter

Trim Panel - Windshield Side Garnish Moulding

Headliner

2002 Lincoln LS Contents/Index
GROUP 01: Body

SECTION 501-08:
Exterior Trim and Ornamentation

REMOVAL AND INSTALLATION
Radiator Grille

License Plate Housing

2002 Lincoln LS Contents/Index
GROUP 01: Body

SECTION 501-09:
Rear View Mirrors

SPECIFICATIONS

DESCRIPTION AND OPERATION

Rear View Mirrors

Rear View Mirrors

DIAGNOSIS AND TESTING

Rear View Mirrors

Principles of Operation

Pinpoint Tests

REMOVAL AND INSTALLATION

Mirror - Exterior Rear View

Mirror - Glass

Mirror - Motor

Mirror - Interior Rear View

Switch - Exterior Rear View Mirror Control

2002 Lincoln LS Contents/Index
GROUP 01: Body

SECTION 501-10:
Seating

SPECIFICATIONS

DESCRIPTION AND OPERATION

Seats

Seats - Front

Seats - Rear

Seats - Power Recliner

Seats - Power Lumbar Support

Seats - Manual Lumbar Support

Seats - Memory Set

Seats - Heated

Side Air Bag

Seats - Driver Seat Module

DIAGNOSIS AND TESTING

Seats

Restraint System Diagnostic Tool Warning

Principles of Operation

Inspection and Verification

Symptom Chart

GENERAL PROCEDURES

Supplemental Restraint System (SRS) Deactivation and Reactivation

REMOVAL AND INSTALLATION

Seat Control Switch

Heated Seat Switch

Lumbar Control Switch

Front Seat Backrest

Seat Backrest - Rear Side Bolsters

Front Seat

Seat - Front Cushion Side Shield

Seat - Rear Cushion

Seat Track

Seat - Rear Seatback

Heated Seat Module

Motor - Front Seat Lumbar

DISASSEMBLY AND ASSEMBLY

Front Seat Cushion

Front Seat Backrest

2002 Lincoln LS Contents/Index
GROUP 01: Body

SECTION 501-11:
Glass, Frames and Mechanisms

SPECIFICATIONS

DESCRIPTION AND OPERATION

Glass, Frames and Mechanisms

DIAGNOSIS AND TESTING

Glass, Frames and Mechanisms

Principles of Operation

Front Electronics Module (FEM) and Rear Electronics Module (REM)

Driver Door Module (DDM)

Module Inputs and Outputs

Master Window Regulator Control Switch

Passenger Window Power Supply

Passenger Window Lock-Out

Passenger Front Power Window

Left Rear (LR) and Right Rear (RR) Power Windows

Rear Window Defrost

Diagnosis

Delayed Accessory

Heated Wiper Park

Symptom Chart

Pinpoint Tests

Component Test

GENERAL PROCEDURES

Lead Terminal Repair

REMOVAL AND INSTALLATION

Switch - Master Window Regulator Control

Window Glass - Back

Window Glass - Front Door

Window Glass - Rear Door

Window Glass - Rear Quarter

Window Regulator - Front Door

Window Regulator - Rear Door

Motor and Window Regulator - Front Door

Motor and Window Regulator - Rear Door

Windshield Glass

2002 Lincoln LS Contents/Index
GROUP 01: Body

SECTION 501-12:
Instrument Panel and Console

SPECIFICATIONS

DESCRIPTION AND OPERATION

Instrument Panel

Console - Floor

REMOVAL AND INSTALLATION

Instrument Panel

Instrument Panel - Cluster Finish Panel

Console - Floor

Console - Floor, Finish Panel Assembly

Glove Compartment

2002 Lincoln LS Contents/Index
GROUP 01: Body

SECTION 501-14A:
Handles, Locks, Latches and Mechanisms

SPECIFICATIONS

DESCRIPTION AND OPERATION

Handles, Locks, Latches And Mechanisms

DIAGNOSIS AND TESTING

Locks, Latches And Mechanisms

REMOVAL AND INSTALLATION

Latch - Front Door

Latch - Rear Door

Handle - Exterior Front Door

Handle - Exterior Rear Door

Handle - Interior Door

Lock Cylinder - Door

Latch Remote Control - Fuel Door Release

Switch - Fuel and Luggage Compartment Lid Release

Switch - Luggage Compartment Lid Lockout

2002 Lincoln LS Contents/Index
GROUP 01: Body

SECTION 501-14B:
Keyless Entry/Computer Operated Locks

DESCRIPTION AND OPERATION
Keyless Entry

DIAGNOSIS AND TESTING

Keyless Entry

Principles of Operation

Inspection and Verification

Symptom Chart

Pinpoint Tests

GENERAL PROCEDURES

Programming - Remote Keyless Entry Transmitter

2002 Lincoln LS Contents/Index
GROUP 01: Body

SECTION 501-16:
Wipers and Washers

SPECIFICATIONS

DESCRIPTION AND OPERATION

Wipers and Washers

DIAGNOSIS AND TESTING

Wipers and Washers

Principles of Operation

Inspection and Verification

Symptom Chart

Pinpoint Tests

Component Test

Windshield Wiper Motor

GENERAL PROCEDURES

Wiper Blade and Pivot Arm Adjustment

REMOVAL AND INSTALLATION

Pivot Arm

Mounting Arm and Pivot Shaft

Windshield Wiper Motor

Washer Pump and Reservoir

Module - Rain Sensor

2002 Lincoln LS Contents/Index
GROUP 01: Body

SECTION 501-17:
Roof Opening Panel

SPECIFICATIONS

DESCRIPTION AND OPERATION

Roof Opening Panel

DIAGNOSIS AND TESTING

Roof Opening Panel

Principles of Operation

Inspection and Verification

Symptom Chart

Pinpoint Tests

GENERAL PROCEDURES

Height Adjustment

Timing Adjustment

REMOVAL AND INSTALLATION

Panel - Roof Opening Assembly

Glass - Roof Opening Assembly

Opening Shield - Roof Opening Panel

Motor - Roof Opening Panel Assembly

Trough Assembly

Air Deflector

Switch - Roof Opening Panel

Module - Roof Opening Panel Control

2002 Lincoln LS Contents/Index
GROUP 01: Body

SECTION 501-19:
Bumpers

SPECIFICATIONS

DESCRIPTION AND OPERATION

Bumpers

REMOVAL AND INSTALLATION

Bumper Cover - Front

Bumper Cover - Rear

Bumper Cover - Trim, Front

Bumper Cover - Trim, Rear

Bumper - Front

Bumper - Rear

SECTION 501-20A:
Safety Belt System

SPECIFICATIONS

DESCRIPTION AND OPERATION

Safety Belt System

Pretensioner System

Safety Belt, Lap/Shoulder

Safety Belt, Buckle End Front

Safety Belt, Lap/Shoulder Dual Locking Mode

Child Safety Seat Tether Anchors

Attaching Safety Seats With Tether Straps

Lower Anchors and Tethers for CHildren (LATCH)

Safety Belt Warning System

Belt Minder

DIAGNOSIS AND TESTING

Safety Belt System

Inspection and Verification

Symptom Chart

Component Test

GENERAL PROCEDURES

Supplemental Restraint System (SRS) Deactivation and Reactivation

Safety Belt Cleaning

Safety Belt Maintenance

Replacement of the Weld Nut and Reinforcement

Safety Belt Shoulder Height Adjuster With Stripped Weld Nuts

Safety Belt Procedure After a Collision

Safety Belt Tongue Rotated on Belt

REMOVAL AND INSTALLATION

Retractor - Rear Center Safety Belt

Retractor - Rear LH and RH Safety Belt

Child Safety Seat Tether Anchor

Height Adjuster - Front Shoulder Safety Belt

Safety Belt Buckle - Front

Child Safety Seat Tether Anchor - LATCH

Safety Belt Buckle - Rear

Safety Belt Retractor and Pretensioner

SECTION 501-20B:
Supplemental Restraint System

SPECIFICATIONS

DESCRIPTION AND OPERATION

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

Driver Air Bag Module

Clockspring

Driver Seat Side Air Bag Module

Passenger Seat Side Air Bag Module

Passenger Air Bag Module

Safety Belt Pretensioners

Restraints Control Module (RCM)

Electrical System

Sensors

Vehicle Emergency Messaging Subsystem (VEMS)

DIAGNOSIS AND TESTING

Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

Diagnosing Customer Concerns Without Hard Diagnostic Trouble Codes (DTCs)

Diagnosing Customer Concerns with Hard Diagnostic Trouble Codes (DTCs)

Deactivation and Reactivation Procedures

Deactivation Procedure Seats Removed

Reactivation Procedure Seats Removed

Deactivation Procedure Seats Not Removed

Reactivation Procedure Seats Not Removed

Prove Out Procedure

Glossary

Air Bag Reconnect Checklist

Diagnostic Instructions - Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

Diagnostic Test Modes

Retrieve/Clear Continuous DTCs

On-Demand Self Test

PID/Data Monitor and Record

Active Commands

Inspection and Verification

Symptom Chart

Pinpoint Tests - Air Bag and Safety Belt Pretensioner Supplemental Restraint System (SRS)

Pinpoint Test AJ: No Communication with the Restraints Control Module (RCM)

GENERAL PROCEDURES

Supplemental Restraint System (SRS) Deactivation and Reactivation

Inspection and Repair After a Supplemental Restraint System (SRS) Deployment

Air Bag Disposal - Deployed

Air Bag Disposal - Undeployed Inoperative

Air Bag Disposal - Driver, Undeployed, Scrapped Vehicle

Remote Deployment

Air Bag Disposal - Passenger, Undeployed, Scrapped Vehicle

Air Bag Disposal - Side, Undeployed, Scrapped Vehicle

Safety Belt Pretensioner Disposal - Deployed

Safety Belt Pretensioner Disposal - Undeployed, Inoperative

Safety Belt Pretensioner Disposal - Undeployed, Scrapped Vehicle

Wiring Repair

Weld Nut Repair - "J" Nut, Restraints Control Module (RCM) and Side Impact Sensor

Weld Nut Repair - Missing Weld Nut, Restraints Control Module (RCM) and Side Impact Sensor

Weld Nut Repair - Stripped Weld Nut, Restraints Control Module (RCM) and Side Impact Sensor

REMOVAL AND INSTALLATION

Side Impact Sensor

Restraints Control Module (RCM)

Driver Air Bag Module

Passenger Air Bag Module

Side Air Bag Module

Clockspring

SECTION 502-00:
Uni-Body, Subframe and Mounting System

SPECIFICATIONS

GENERAL PROCEDURES

Body Misalignment Check

Underbody Misalignment Check

REMOVAL AND INSTALLATION

Subframe - Rear

Crossmember - Front

Crossmember - Front I-Brace Bracket

2002 Lincoln LS Contents/Index
GROUP 03: Engine

SECTION 303-00:
Engine System General Information

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine

DIAGNOSIS AND TESTING

Engine

Inspection and Verification

Symptom Chart

Component Tests

Compression Test Compression Gauge Check

Cylinder Leakage Detection

Oil Consumption Test

Intake Manifold Vacuum Test

Excessive Engine Oil Consumption

Valve Train Analysis Engine Off Valve Cover Removed

GENERAL PROCEDURES

Sprockets

Camshaft Journal Diameter

Camshaft Journal Clearance, Plastigage Method

Camshaft End Play OHC Engines

Camshaft Lobe Surface

Camshaft Lobe Lift

Camshaft Runout

Crankshaft Main Bearing Journal Diameter

Crankshaft Main Bearing Journal Taper

Crankshaft Main Bearing Journal Clearance

Crankshaft End Play

Crankshaft Runout

Crankshaft Connecting Rod Journal Taper, Out of Round

Cylinder Bore Taper

Cylinder Bore Out-of-Round

Piston Inspection

Piston Pin to Bore Diameter

Piston Diameter

Piston to Cylinder Bore Clearance

Piston Selection

Piston Ring End Gap

Piston Ring-to-Groove Clearance

Piston Pin Diameter

Connecting Rod Cleaning

Connecting Rod Large End Bore

Connecting Rod Bushing Diameter

Connecting Rod Bend

Connecting Rod Twist

Connecting Rod Piston Pin Side Clearance

Connecting Rod Bearing Journal Clearance

Valve Stem Diameter

Valve Stem to Valve Guide Clearance

Valve Inspection

Valve Guide Inner Diameter

Valve Spring Free Length

Valve Spring Squareness

Valve Spring Strength

Valve Seat Inspection

Valve Seat Width

Valve Seat Runout

Cylinder Head Distortion

Cylinder Bore Cleaning

Cylinder Block Distortion

Cylinder Block Core Plug Replacement

Exhaust Manifold Inspection

Bearing Inspection

2002 Lincoln LS Contents/Index
GROUP 03: Engine

SECTION 303-01A:
Engine 3.0L (4V)

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine

DIAGNOSIS AND TESTING

Engine

IN-VEHICLE REPAIR

Upper Intake Manifold

Lower Intake Manifold

Valve Cover LH

Valve Cover RH

Crankshaft Pulley

Crankshaft Front Oil Seal

Engine Front Cover

Timing Drive Components

Camshafts LH

Camshafts RH

Exhaust Manifold LH

Exhaust Manifold RH

Cylinder Head LH

Cylinder Head RH

Oil Level Indicator and Tube

Oil Filter Adapter

Oil Pan

Oil Cooler

Oil Pressure Switch - Oil Cooler

Oil Pump

Flexplate

Crankshaft Rear Oil Seal

Flywheel

Valve Spring - Lash Adjustment

Valve Spring - Springs, Retainers, and Stem Seals

Valve Tappet

Engine Mount - LH

Engine Mount - RH

REMOVAL

Engine

DISASSEMBLY

Engine

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Cylinder Head

Piston

ASSEMBLY

Engine

INSTALLATION

Engine

2002 Lincoln LS Contents/Index
GROUP 03: Engine

SECTION 303-01B:
Engine 3.9L

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine

DIAGNOSIS AND TESTING

Engine

GENERAL PROCEDURES

Valve Clearance Adjustment

Valve Clearance Check

IN-VEHICLE REPAIR

Intake Manifold

Valve Cover LH

Valve Cover RH

Crankshaft Pulley

Crankshaft Front Oil Seal

Engine Front Cover

Timing Drive Components Primary

Timing Drive Components Secondary

Valve Springs

Valve Seals

Camshaft

Exhaust Manifold LH

Exhaust Manifold RH

Cylinder Head

Oil Cooler

Oil Filter Adapter

Oil Level Indicator and Tube

Oil Pan

Oil Pump

Oil Pump Screen and Pickup Tube

Flexplate

Crankshaft Rear Oil Seal

Engine Mount

REMOVAL

Engine

DISASSEMBLY

Engine

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Cylinder Head

ASSEMBLY

Engine

INSTALLATION

Engine

2002 Lincoln LS Contents/Index
GROUP 03: Engine

SECTION 303-03:
Engine Cooling

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine Cooling

DIAGNOSIS AND TESTING

Engine Cooling

Inspection and Verification

Symptom Chart

Pinpoint Tests

Component Tests

Pressure Test

Cap

Thermostat - Water

Thermostat - Electrical Test

Thermostat - Mechanical Test

Radiator Leak Test, Removed From the Vehicle

Hydraulic Cooling Fan Reservoir

Hydraulic Cooling Fan Motor

Hydraulic Cooling Fan Pump

GENERAL PROCEDURES

Cooling System Draining, Filling And Bleeding

Draining

Filling - Bleeding

Hydraulic Cooling Fan System Filling and Bleeding

Engine and Radiator Flushing

Vehicle Demagnetizing

Heater Core Backflushing

REMOVAL AND INSTALLATION

Thermostat - 3.9L

Thermostat Housing - 3.0L

Thermostat Housing - 3.9L

Coolant Outlet Pipe - 3.0L

Coolant Inlet Pipe - 3.0L

Coolant Outlet Pipe - 3.9L

Water Pump - 3.0L

Water Pump - 3.9L

Cooling Fan Motor and Shroud

Fan - Pump, 3.0L

Fan - Pump, 3.9L

Degas Bottle

2002 Lincoln LS Contents/Index

GROUP 03: Engine

SECTION 303-04A:
Fuel Charging and Controls 3.0L (4V)

SPECIFICATIONS

DESCRIPTION AND OPERATION

Fuel Charging And Controls

DIAGNOSIS AND TESTING

Fuel Charging And Controls

REMOVAL AND INSTALLATION

Throttle Body

Fuel Pressure Relief Valve

2002 Lincoln LS Contents/Index

GROUP 03: Engine

SECTION 303-04B:
Fuel Charging and Controls 3.9L

SPECIFICATIONS

DESCRIPTION AND OPERATION

Fuel Charging And Controls

DIAGNOSIS AND TESTING

Fuel Charging And Controls

REMOVAL AND INSTALLATION

Throttle Body

Fuel Injectors

Fuel Injection Supply Manifold

2002 Lincoln LS Contents/Index

GROUP 03: Engine

SECTION 303-05:
Accessory Drive

SPECIFICATIONS

DESCRIPTION AND OPERATION

Accessory Drive

DIAGNOSIS AND TESTING

Accessory Drive

Inspection and Verification

Symptom Chart

Component Tests

REMOVAL AND INSTALLATION

Accessory Drive Belt - 3.0L

Accessory Drive Belt - 3.9L

Belt Tensioner

Accessory Drive Belt Idler Pulley

2002 Lincoln LS Contents/Index
GROUP 03: Engine

SECTION 303-06:
Starting System

SPECIFICATIONS

DESCRIPTION AND OPERATION

Starting System

DIAGNOSIS AND TESTING

Starting System

Principles of Operation

Insection and Verification

Symptom Chart

Pinpoint Tests

Component Tests

Starter Motor Ground Circuit

GENERAL PROCEDURES

Starter Drive and Flywheel Ring Gear Inspection

REMOVAL AND INSTALLATION

Starter Motor 3.0L

Starter Motor 3.9L

2002 Lincoln LS Contents/Index

GROUP 03: Engine

SECTION 303-07A:
Engine Ignition 3.0L (4V)

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine Ignition

DIAGNOSIS AND TESTING

Engine Ignition

REMOVAL AND INSTALLATION

Ignition Coil

Spark Plug

2002 Lincoln LS Contents/Index

GROUP 03: Engine

SECTION 303-07B:
Engine Ignition 3.9L

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine Ignition

DIAGNOSIS AND TESTING

Engine Ignition

REMOVAL AND INSTALLATION

Ignition Coil

Spark Plugs

SECTION 303-08:
Engine Emission Control

SPECIFICATIONS

DESCRIPTION AND OPERATION

Engine Emission Control

DIAGNOSIS AND TESTING

Engine Emission Control

REMOVAL AND INSTALLATION

Exhaust Gas Recirculation (EGR) Valve

Exhaust Manifold To Exhaust Gas Recirculation (EGR) Valve Tube - 3.0L

Exhaust Manifold To Exhaust Gas Recirculation (EGR) Valve Tube - 3.9L

Differential Pressure Feedback Exhaust Gas Recirculation (EGR) System - 3.0L

Differential Pressure Feedback Exhaust Gas Recirculation (EGR) System - 3.9L

Exhaust Gas Recirculation (EGR) Vacuum Regulator Solenoid - 3.0L

Exhaust Gas Recirculation (EGR) Vacuum Regulator Solenoid - 3.9L

Positive Crankcase Ventilation (PCV) Valve - 3.0L

Positive Crankcase Ventilation (PCV) Hose - 3.0L

Crankcase Vent Oil Separator - 3.0L

Secondary Air Pump - 3.0L

Secondary Air Valve - 3.0L

Secondary Air Valve - Tube, 3.0L

2002 Lincoln LS Contents/Index
GROUP 03: Engine

SECTION 303-12:
Intake Air Distribution and Filtering

SPECIFICATIONS

DESCRIPTION AND OPERATION

Intake Air Distribution And Filtering

DIAGNOSIS AND TESTING

Intake Air Distribution And Filtering

REMOVAL AND INSTALLATION

Air Cleaner Outlet Pipe - 3.0L

Air Cleaner Outlet Pipe - 3.9L

Air Cleaner - Outlet

Air Cleaner - Inlet

Air Cleaner Element

2002 Lincoln LS Contents/Index
GROUP 03: Engine

SECTION 303-13:
Evaporative Emissions

SPECIFICATIONS

DESCRIPTION AND OPERATION

Evaporative Emissions

DIAGNOSIS AND TESTING

Evaporative Emissions

Principles of Operation

Inspection and Verification

Symptom Chart

Pinpoint Tests

GENERAL PROCEDURES

Evaporative Emission System Leak Test

Canister Vent Solenoid Closing Procedure

Evaporative Emission Repair Verification Drive Cycle

REMOVAL AND INSTALLATION

Evaporative Emission Canister

Evaporative Emission Canister Purge Valve

Fuel Vapor Control Tube Assembly Valve

Evaporative Emission Canister Vent Solenoid

SECTION 303-14:
Electronic Engine Controls

SPECIFICATIONS

DESCRIPTION AND OPERATION

Electronic Engine Controls

DIAGNOSIS AND TESTING

Electronic Engine Controls

REMOVAL AND INSTALLATION

Intake Manifold Tuning (IMT) Valve - 3.0L

Camshaft Position (CMP) Sensor - 3.0L

Camshaft Position (CMP) Sensor - 3.9L

Crankshaft Position (CKP) Sensor - 3.0L

Crankshaft Position (CKP) Sensor - 3.9L

Power Steering Pressure (PSP) Switch - 3.0L

Power Steering Pressure (PSP) Switch - 3.9L

Powertrain Control Module (PCM)

Throttle Position (TP) Sensor - 3.0L

Throttle Position (TP) Sensor - 3.9L

Idle Air Control (IAC) Valve - 3.0L

Idle Air Control (IAC) Valve - 3.9L

Cylinder Head Temperature (CHT) Sensor - 3.0L

Cylinder Head Temperature (CHT) Sensor - 3.9L

Mass Air Flow (MAF) Sensor

Intake Air Temperature (IAT) Sensor

Heated Oxygen Sensor (HO2S) - 3.0L, 3.9L, Front

Catalyst Monitor Sensor - 3.0L (A/T), 3.9L

Catalyst Monitor Sensor 3.0L (M/T)

Knock Sensor (KS) 3.0L

Knock Sensor (KS) 3.9L

Clutch Pedal Position (CPP) Switch

Fuel Pressure Sensor 3.0L

Fuel Pressure Sensor 3.9L

Fuel Temperature Sensor 3.0L

2002 Lincoln LS Contents/Index

GROUP 04: Suspension

SECTION 204-00:
Suspension System General Information

SPECIFICATIONS

DESCRIPTION AND OPERATION

Wheel Alignment Angles

Camber

Caster

Toe

Ride Height

Wheel Track

Dogtracking

Wander

Shimmy

Nibble

Poor Returnability/Sticky Steering

Drift/Pull

Poor Groove Feel

DIAGNOSIS AND TESTING

Suspension System

Inspection and Verification

Symptom Chart

Component Tests

Ball Joint Inspection

GENERAL PROCEDURES

Wheel Bearing Inspection Front and Rear

Camber and Caster Adjustment

Front Toe Adjustment

Rear Toe Adjustment

SECTION 204-01:
Front Suspension

SPECIFICATIONS

DESCRIPTION AND OPERATION

Front Suspension

DIAGNOSIS AND TESTING

Front Suspension

REMOVAL AND INSTALLATION

Wheel Bearing and Hub

Wheel Studs

Lower Arm

Upper Arm - Left Side

Upper Arm - Right Side

Stabilizer Bar

Stabilizer Bar Link

Stabilizer Bar Bushing

Wheel Knuckle

Shock Absorber and Spring Assembly

DISASSEMBLY AND ASSEMBLY

Shock Absorber and Spring Assembly

2002 Lincoln LS Contents/Index
GROUP 04: Suspension

SECTION 204-02:
Rear Suspension

SPECIFICATIONS

DESCRIPTION AND OPERATION

Rear Suspension

DIAGNOSIS AND TESTING

Rear Suspension

REMOVAL AND INSTALLATION

Wheel Hub

Wheel Studs

Upper Arm

Lower Arm

Stabilizer Bar

Stabilizer Bar Link

Toe Link

Stabilizer Bar Bushing

Wheel Knuckle

Shock Absorber and Spring Assembly

DISASSEMBLY AND ASSEMBLY

Shock Absorber and Spring Assembly

SECTION 204-04:
Wheels and Tires

SPECIFICATIONS

DESCRIPTION AND OPERATION

Safety Precautions

Wheels And Tires

DIAGNOSIS AND TESTING

Wheels And Tires

Inspection and Verification

Road Test

Symptom Chart

Component Tests

Tire and Wheel Runout

Tire Runout

Wheel Runout

GENERAL PROCEDURES

Wheel Leaks

REMOVAL AND INSTALLATION

Wheel And Tire

2002 Lincoln LS Contents/Index

GROUP 05: Driveline

SECTION 205-00:
Driveline System General Information

SPECIFICATIONS

DESCRIPTION AND OPERATION

Driveline System

DIAGNOSIS AND TESTING

Driveline System

Inspection and Verification

Noise Acceptability

Driveshaft Center Universal Joint (U-Joint) Inspection

Analysis of Leakage

Analysis of Vibration

Component Tests

Driveline Vibration

Pinion Flange Runout Check

GENERAL PROCEDURES

Driveline Angle Inspection

2002 Lincoln LS Contents/Index

GROUP 05: Driveline

SECTION 205-01:
Driveshaft

SPECIFICATIONS

DESCRIPTION AND OPERATION

Driveshaft

Universal Joints

DIAGNOSIS AND TESTING

Driveshaft

GENERAL PROCEDURES

Driveshaft Runout and Balancing

REMOVAL AND INSTALLATION

Driveshaft

DISASSEMBLY AND ASSEMBLY

Driveshaft Center Bearing

Driveshaft Alignment Bushing

2002 Lincoln LS Contents/Index

GROUP 05: Driveline

SECTION 205-02:
Rear Drive Axle/Differential

SPECIFICATIONS

DESCRIPTION AND OPERATION

Rear Drive Axle and Differential

DIAGNOSIS AND TESTING

Rear Drive Axle and Differential

IN-VEHICLE REPAIR

Stub Shaft Pilot Bearing and Seal

Drive Pinion Flange and Drive Pinion Seal

REMOVAL AND INSTALLATION

Axle Housing

Axle Housing Bushing

DISASSEMBLY AND ASSEMBLY

Axle - Aluminum

Axle - Nodular Iron

2002 Lincoln LS Contents/Index

GROUP 05: Driveline

SECTION 205-05:
Rear Drive Halfshafts

SPECIFICATIONS

DESCRIPTION AND OPERATION

Rear Drive Halfshafts

DIAGNOSIS AND TESTING

Rear Drive Halfshafts

REMOVAL AND INSTALLATION

Halfshaft

DISASSEMBLY AND ASSEMBLY

Halfshaft Joint

SECTION 206-00:
Brake System General Information

SPECIFICATIONS

DESCRIPTION AND OPERATION

Brake System

Brake System, Hydraulic

Master Cylinder, Dual

Booster, Power Brake

Brakes, Front Disc

Brakes, Rear Disc

Brake System, Parking

Brake Hose

DIAGNOSIS AND TESTING

Brake System

Symptom Chart

Pinpoint Tests

Component Tests

GENERAL PROCEDURES

Brake System Bleeding

Brake System Leak Check

2002 Lincoln LS Contents/Index

GROUP 06: Brake System

SECTION 206-03:
Front Disc Brake

SPECIFICATIONS

DESCRIPTION AND OPERATION

Front Disc Brake

Brake Fluid

DIAGNOSIS AND TESTING

Front Disc Brake

REMOVAL AND INSTALLATION

Brake Pads

Brake Caliper

Brake Caliper Anchor Plate

Brake Disc

Brake Disc Shield

DISASSEMBLY AND ASSEMBLY

Brake Caliper

2002 Lincoln LS Contents/Index

GROUP 06: Brake System

SECTION 206-04:
Rear Disc Brake

SPECIFICATIONS

DESCRIPTION AND OPERATION

Rear Disc Brake

DIAGNOSIS AND TESTING

Rear Disc Brake

REMOVAL AND INSTALLATION

Brake Caliper

Brake Pads

Brake Disc

Brake Caliper Support Bracket

Brake Disc Shield

DISASSEMBLY AND ASSEMBLY

Brake Caliper

2002 Lincoln LS Contents/Index

GROUP 06: Brake System

SECTION 206-05:
Parking Brake and Actuation

SPECIFICATIONS

DESCRIPTION AND OPERATION

Parking Brake

DIAGNOSIS AND TESTING

Parking Brake

Inspection and Verification

Symptom Chart

REMOVAL AND INSTALLATION

Parking Brake Control

Parking Brake Cable - Front

Parking Brake Cable - Rear

2002 Lincoln LS Contents/Index

GROUP 06: Brake System

SECTION 206-06:
Hydraulic Brake Actuation

SPECIFICATIONS

DESCRIPTION AND OPERATION

Hydraulic Brake Actuation

Brake Master Cylinder

Brake Master Cylinder Reservoir

Brake Tubes and Hoses

DIAGNOSIS AND TESTING

Hydraulic Brake Actuation

REMOVAL AND INSTALLATION

Brake Pedal And Bracket

Brake Master Cylinder

Brake Fluid Reservoir

2002 Lincoln LS Contents/Index
GROUP 06: Brake System

SECTION 206-07:
Power Brake Actuation

SPECIFICATIONS

DESCRIPTION AND OPERATION

Brake Booster

Hose and Check Valve

DIAGNOSIS AND TESTING

Power Brake System

REMOVAL AND INSTALLATION

Brake Booster

SECTION 206-09A:
Anti-Lock Control

SPECIFICATIONS

DESCRIPTION AND OPERATION

Anti-Lock Control

DIAGNOSIS AND TESTING

Anti-Lock Control

Principles of Operation

Inspection and Verification

Anti-Lock Brake Control Module Diagnostic Trouble Code (DTC) Index

Symptom Chart

Pinpoint Tests

REMOVAL AND INSTALLATION

Hydraulic Control Unit (HCU)

Anti-Lock Brake System (ABS) Module

Front Wheel Speed Sensor

Rear Wheel Speed Sensor

SECTION 206-09B:
Anti-Lock Control Traction Control

SPECIFICATIONS

DESCRIPTION AND OPERATION

Anti-Lock Control Traction Control

DIAGNOSIS AND TESTING

Anti-Lock Control Traction Control

Principles of Operation

Inspection and Verification

Symptom Chart

Pinpoint Tests

REMOVAL AND INSTALLATION

Hydraulic Control Unit (HCU)

Anti-Lock Brake System (ABS) Module

Front Wheel Speed Sensor

Rear Wheel Speed Sensor

Traction Control Actuator

SECTION 206-09C:
Anti-Lock Control Traction Control and Stability Assist

SPECIFICATIONS

DESCRIPTION AND OPERATION

Anti-Lock Control Traction Control and Stability Assist

DIAGNOSIS AND TESTING

Anti-Lock Control Traction Control and Stability Assist

Principles of Operation

Inspection and Verification

Stability Assist Module Diagnostic Trouble Code (DTC) Index

Stability Assist Module Parameter Identification (PID) Index

Stability Assist Module Active Command Index

Stability Assist Calibration List

Symptom Chart

Pinpoint Tests

REMOVAL AND INSTALLATION

Hydraulic Control Unit (HCU)

Anti-Lock Brake System (ABS) Module Stability Assist

Front Wheel Speed Sensor

Rear Wheel Speed Sensor

Yaw Rate Sensor

Traction Control Actuator Advance Trac

Accelerometer

Transducer Primary

Transducer Secondary

SECTION 307-01:
Automatic Transmission 5R55N

SPECIFICATIONS

DESCRIPTION AND OPERATION

Transmission Description

Identification Tags

Range Selection

Shift Patterns

Disassembled Views

Bushings, Bearing and Thrust Washer Locator

Seals, Rings and Gaskets Locator

Torque Converter

Geartrain

Apply Components

Hydraulic System

Transmission Electronic Control System

DIAGNOSIS AND TESTING

Diagnostic Strategy

Diagnostic Flow Chart

Preliminary Inspection

Know and Understand the Concern

Verification of Condition

Torque Converter Diagnosis

Visual Inspection

Shift Linkage Check

Diagnostics

On-Board Diagnostics with NGS

Output State Control (OSC) Mode

Transmission Drive Cycle Test

After On-Board Diagnostics

Before Pinpoint Tests

Diagnostic Trouble Code Charts

Rotunda Transmission Tester

Transmission Connector Layouts

Pinpoint Tests - OSC Equipped Vehicles

Shift Solenoid Pre-Diagnosis

Pinpoint Tests

Special Testing Procedures

Leakage Inspection

Transmission Fluid Cooler

Diagnosis By Symptom

GENERAL PROCEDURES

Transmission Fluid Level Check

Transmission Fluid Cooler - Backflushing and Cleaning

Transmission Fluid Drain and Refill - Automated Equipment

Transmission Fluid Drain and Refill - Vehicles With Torque Converter Drain Plug

Transmission Fluid Drain and Refill - Vehicles Without Torque Converter Drain Plug

Transmission Range (TR) Sensor Adjustment

IN-VEHICLE REPAIR

Fluid Pan, Gasket and Filter

Main Control Valve Body

Extension Housing Seal

Extension Housing Gasket

Solenoid Body Assembly

Digital Transmission Range (TR) Sensor

Reverse Servo Assembly

Park System

Transmission Support Insulator

REMOVAL

Transmission

DISASSEMBLY

Transmission

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Main Control Valve Body

Fluid Pump

Overdrive Brake and Coast Clutch Drum Assembly

Direct Clutch Drum Assembly

Forward Clutch Bonded Piston

Overdrive Planetary and One-Way Clutch Assembly

Overdrive Planetary Gears

Center Support

Reverse Brake Drum

Output Shaft Ring Gear and Hub Shaft Assembly

Reverse Servo Assembly

Torque Converter

Torque Converter Cleaning And Inspection

Torque Converter Flushing

Torque Converter Leak Check

Torque Converter Impeller to Pump Stator Interference Check

Torque Converter End Play Check

Torque Converter One-Way Clutch Check

Torque Converter Turbine to Pump Stator Interference Check

ASSEMBLY

Transmission

INSTALLATION

Transmission

SECTION 307-02:
Transaxle/Transmission Cooling

SPECIFICATIONS

DESCRIPTION AND OPERATION

Transmission Cooling

DIAGNOSIS AND TESTING

Transmission Cooling

Inspection and Verification

Symptom Chart

GENERAL PROCEDURES

Transmission Fluid Cooler Flow Test

Transmission Fluid Cooler Backflushing and Cleaning

REMOVAL AND INSTALLATION

Combination Fluid Cooler

Transmission Fluid Cooler Tubes

SECTION 307-05:
Automatic Transaxle/Transmission External Controls

SPECIFICATIONS

DESCRIPTION AND OPERATION

External Controls

DIAGNOSIS AND TESTING

External Controls

Inspection and Verification

Symptom Chart

Pinpoint Tests

GENERAL PROCEDURES

Cable Adjustment

REMOVAL AND INSTALLATION

Brake Shift Interlock Actuator

Cable

Selector Lever

Transmission Control Switch

SECTION 308-00:
Manual Transaxle/Transmission and Clutch General Information

SPECIFICATIONS

DESCRIPTION AND OPERATION

Manual Transmission and Clutch

DIAGNOSIS AND TESTING

Manual Transmission and Clutch

GENERAL PROCEDURES

Bleed Procedure

Release Hub and Bearing Check

SECTION 308-01:
Clutch

SPECIFICATIONS

DESCRIPTION AND OPERATION

Clutch

DIAGNOSIS AND TESTING

Clutch

REMOVAL AND INSTALLATION

Flywheel

Bearing - Pilot

Disc and Pressure Plate

SECTION 308-02:
Clutch Controls

SPECIFICATIONS

DESCRIPTION AND OPERATION

Clutch Controls

DIAGNOSIS AND TESTING

Clutch Controls

REMOVAL AND INSTALLATION

Clutch Pedal

Clutch Master Cylinder

Slave Cylinder

Hydraulic Tubes

SECTION 308-03:
Manual Transaxle/Transmission

SPECIFICATIONS

DESCRIPTION AND OPERATION

Manual Transmission

DIAGNOSIS AND TESTING

Manual Transmission

GENERAL PROCEDURES

Fill Procedure

Drain Procedure

IN-VEHICLE REPAIR

Vehicle Speed Sensor (VSS)

Seal - Selector Shaft

Seal - Input Shaft

Seal - Output Shaft

Support Insulator

REMOVAL

Transmission

INSTALLATION

Transmission

2002 Lincoln LS Contents/Index

GROUP 09: Exhaust System

SECTION 309-00:
Exhaust System

SPECIFICATIONS

DESCRIPTION AND OPERATION

Exhaust System

DIAGNOSIS AND TESTING

Exhaust System

Inspection and Verification

Symptom Chart

Pinpoint Tests

REMOVAL AND INSTALLATION

Muffler

Catalytic Converter

Exhaust Heat Shield - Front

Exhaust Heat Shield - Underbody

Exhaust Heat Shield - Catalytic Converter

2002 Lincoln LS Contents/Index

GROUP 10: Fuel System

SECTION 310-00:
Fuel System General Information

SPECIFICATIONS

DESCRIPTION AND OPERATION

Fuel System

DIAGNOSIS AND TESTING

Fuel System

GENERAL PROCEDURES

Pressure Relief

Draining

Coupling Spring Lock

Fittings R-Clip

Fittings Vapor Tube

2002 Lincoln LS Contents/Index

GROUP 10: Fuel System

SECTION 310-01:
Fuel Tank and Lines

SPECIFICATIONS

DESCRIPTION AND OPERATION

Fuel Tank And Lines

DIAGNOSIS AND TESTING

Fuel Tank And Lines

REMOVAL AND INSTALLATION

Fuel Tank

Fuel Tank Support Straps

Fuel Pump Module

Fuel Transfer Pump

Fuel Tank Filler Pipe

Fuel Filter

Inertia Fuel Shutoff (IFS) Switch

SECTION 310-02:
Acceleration Control

SPECIFICATIONS

DESCRIPTION AND OPERATION

Acceleration Control

DIAGNOSIS AND TESTING

Acceleration Control

REMOVAL AND INSTALLATION

Accelerator Pedal and Shaft

Accelerator Cable

Accelerator Cable Bracket - 3.0L

2002 Lincoln LS Contents/Index

GROUP 10: Fuel System

SECTION 310-03:
Vehicle Speed Control

SPECIFICATIONS

DESCRIPTION AND OPERATION

Vehicle Speed Control

DIAGNOSIS AND TESTING

Vehicle Speed Control

Principles of Operation

Inspection and Verification

PCM Diagnostic Trouble Code (DTC) Index

Symptom Chart

Pinpoint Test

REMOVAL AND INSTALLATION

Speed Control Cable

Speed Control Actuator

Switch - Deactivator

Switch - Speed Control Actuator

← 2002 Lincoln LS Contents/Index
← GROUP 11: Steering System

SECTION 211-00:
Steering System General Information

SPECIFICATIONS

DESCRIPTION AND OPERATION

Steering System

DIAGNOSIS AND TESTING

Steering System

Diagnostic Trouble Code (DTC) Index

Component Tests

Steering Linkage

Pump Flow and Pressure Test

Turning Effort Test

Steering Gear Insulator

Steering Gear Valve

Tie-Rod Articulation Torque

GENERAL PROCEDURES

Power Steering System Flushing

Power Steering System Purging

Power Steering System Filling

SECTION 211-02:
Power Steering

SPECIFICATIONS

DESCRIPTION AND OPERATION

Power Steering

System View

DIAGNOSIS AND TESTING

Power Steering

REMOVAL AND INSTALLATION

Power Steering Fluid Reservoir

Power Steering Pump - 3.9L

Power Steering Pump - 3.0L

Power Steering Pump Pulley - 3.9L

Power Steering Pump Pulley - 3.0L

Power Steering Pump to Steering Gear Pressure Line

Power Steering Fluid Cooler

Steering Gear

Power Steering Control Valve Actuator

Steering Wheel Rotation Sensor

DISASSEMBLY AND ASSEMBLY

Steering Gear

SECTION 211-04:
Steering Column

SPECIFICATIONS

DESCRIPTION AND OPERATION

Steering Column

Ignition Switch

DIAGNOSIS AND TESTING

Steering Column

Steering Column - Tilt/Telescopic Motors

Inspection and Verification

Symptom Chart

Pinpoint Tests

GENERAL PROCEDURES

Supplemental Restraint System (SRS) Deactivation and Reactivation

REMOVAL AND INSTALLATION

Ignition Switch Lock Cylinder

Steering Wheel

Clockspring

Steering Column

Tilt/Telescopic Motors

Steering Column Shaft - Intermediate

SECTION 211-05:
Steering Column Switches

SPECIFICATIONS

DESCRIPTION AND OPERATION

Steering Column Switches

DIAGNOSIS AND TESTING

Steering Column Switches

Inspection and Verification

Symptom Chart

Pinpoint Tests

GENERAL PROCEDURES

Steering Column Lock Module Parameter Reset

REMOVAL AND INSTALLATION

Multifunction Switch

Steering Column Lock Actuator - Manual Transmission

SECTION 412-00:
Climate Control System - General Information

SPECIFICATIONS

DESCRIPTION AND OPERATION

Climate Control System

Dual Automatic Temperature Control (DATC) Module Description

System Air Flow

DIAGNOSIS AND TESTING

Climate Control System

Inspection and Verification

Symptom Chart

Pinpoint Tests

Component Tests

Heater Core

Heater Core - Plugged

Heater Core - Pressure Test

Heater Core - Bench Test

Condenser Core - On-Vehicle Leak Test

A/C Compressor - External Leak Test

GENERAL PROCEDURES

Air Conditioning (A/C) System Check - Retail Procedure

Spring Lock Coupling

Air Conditioning Line (Peanut) Fitting

Heater Hose Coupling

A/C Clutch Air Gap Adjustment

Manifold Gauge Set Connection

Electronic Leak Detection

Fluorescent Dye Leak Detection

Air Conditioning (A/C) System Recovery, Evacuation and Charging

Air Conditioning (A/C) System Flushing

Refrigerant System Filtering After A/C Component Replacement

Refrigerant Oil Adding

Inspection and Assembly Requirements Following An A/C Compressor Failure

Refrigerant Identification Testing

Contaminated Refrigerant Handling

SECTION 412-01:
Air Distribution and Filtering

SPECIFICATIONS

DESCRIPTION AND OPERATION

Air Distribution And Filtering

DIAGNOSIS AND TESTING

Air Distribution And Filtering

REMOVAL AND INSTALLATION

Cabin Air Filter

Fresh Air Inlet Duct

Center Registers

Floor Console Register

Footwell Duct

Footwell Duct Floor Console

Rear Footwell Duct

Plenum Chamber

DISASSEMBLY AND ASSEMBLY

Instrument Panel Air Distribution Ducts

SECTION 412-02:
Heating and Ventilation

SPECIFICATIONS

DESCRIPTION AND OPERATION

Heating and Defrosting

REMOVAL AND INSTALLATION

Heater Hose - Assembly

Blower Motor

Heater Core And Evaporator Core Housing

Heater Core

Valve - Dual Coolant Flow

Pump - Auxiliary Coolant Flow, 3.9L

DISASSEMBLY AND ASSEMBLY

Heater Core And Evaporator Core Housing

2002 Lincoln LS Contents/Index
GROUP 12: Climate Control System

SECTION 412-03:
Air Conditioning

SPECIFICATIONS

DESCRIPTION AND OPERATION

Air Conditioning

A/C Compressor and Clutch Assembly

A/C Compressor Pressure Relief Valve

A/C Condenser Core

Refrigerant Lines

A/C Evaporator Core

A/C Thermostatic Expansion Valve

Receiver Drier

A/C Pressure Transducer

Spring Lock Coupling

Peanut Fitting

Service Gauge Port Valves

DIAGNOSIS AND TESTING

Air Conditioning

REMOVAL AND INSTALLATION

Air Conditioning (A/C) Compressor - 3.0L

Air Conditioning (A/C) Compressor - 3.9L

Air Conditioning (A/C) Compressor Bracket - 3.0L

Clutch and Clutch Field Coil

Evaporator Core

Receiver Drier

Air Conditioning (A/C) Pressure Transducer

Air Conditioning (A/C) Pressure Relief Valve

Condenser Core

Receiver Drier Manifold and Tube Assembly - 3.0L

Receiver Drier Manifold and Tube Assembly - 3.9L

Compressor Manifold and Tube Assembly

Thermostatic Expansion Valve Manifold and Tube Assembly - 3.0L

Thermostatic Expansion Valve Manifold and Tube Assembly - 3.9L

Thermostatic Expansion Valve - 3.9L

2002 Lincoln LS Contents/Index
GROUP 12: Climate Control System

SECTION 412-04:
Control Components

DESCRIPTION AND OPERATION
Control Components
Control System Inputs

Control System Outputs

REMOVAL AND INSTALLATION

Climate Control Assembly

Ambient Air Temperature Sensor

Sunload Sensor

In-Vehicle Temperature Sensor

Air Discharge Temperature Sensor

Blend Door Actuator - Air Inlet Door

Blend Door Actuator - Floor Duct Door

Blend Door Actuator - Cold Air Bypass Door

Blend Door Actuator - Defrost Door

Blend Door Actuator - Panel, Floor Console Door

Blower Motor Speed Control

SECTION 413-00:
Instrument Cluster and Panel Illumination

DESCRIPTION AND OPERATION
Instrument Cluster and Panel Illumination

DIAGNOSIS AND TESTING

Instrument Cluster and Panel Illumination

Principles of Operation

Inspection and Verification

Symptom Chart

Pinpoint Tests

REMOVAL AND INSTALLATION

Switch - Panel Dimmer

SECTION 413-01:
Instrument Cluster

SPECIFICATIONS

DESCRIPTION AND OPERATION

Instrument Cluster

DIAGNOSIS AND TESTING

Instrument Cluster

Principles of Operation

Inspection and Verification

Symptom Chart

Pinpoint Tests

REMOVAL AND INSTALLATION

Instrument Cluster

Cluster Lens

SECTION 413-06:
Horn

SPECIFICATIONS

DESCRIPTION AND OPERATION

Horn

DIAGNOSIS AND TESTING

Horn

Principles of Operation

Inspection and Verification

FEM Diagnostic Trouble Code (DTC) Index

Instrument Cluster Diagnostic Trouble Code (DTC) Index

Symptom Chart

Pinpoint Tests

REMOVAL AND INSTALLATION

Horn

Horn Switch

SECTION 413-08:
Information and Message Center

DESCRIPTION AND OPERATION
Information And Message Center

DIAGNOSIS AND TESTING

Information And Message Center

Principles of Operation

Inspection and Verification

Symptom Chart

Pinpoint Tests

REMOVAL AND INSTALLATION

Switch Message Center

SECTION 413-09:
Warning Devices

DESCRIPTION AND OPERATION
Warning Devices

DIAGNOSIS AND TESTING

Warning Devices

Inspection and Verification

Pinpoint Tests

GENERAL PROCEDURES

Belt Minder Deactivating/Activating

Preparation

Deactivating/Activating

SECTION 414-00:
Charging System General Information

SPECIFICATIONS

DESCRIPTION AND OPERATION

Charging System

DIAGNOSIS AND TESTING

Charging System

Inspection and Verification

Symptom Chart

Pinpoint Tests

Generator On-Vehicle Tests Load Test

SECTION 414-01:
Battery, Mounting and Cables

SPECIFICATIONS

DESCRIPTION AND OPERATION

Battery and Cables

DIAGNOSIS AND TESTING

Battery

Pinpoint Tests

GENERAL PROCEDURES

Battery Disconnect

REMOVAL AND INSTALLATION

Battery

Battery Tray

Battery Cables

SECTION 414-02:
Generator and Regulator

SPECIFICATIONS

DESCRIPTION AND OPERATION

Generator

REMOVAL AND INSTALLATION

Generator - 3.0L

Generator - 3.9L

2002 Lincoln LS Contents/Index
GROUP 15: Audio Systems

SECTION 415-00:
Entertainment System General Information

DIAGNOSIS AND TESTING
Audio System
Inspection and Verification

Audio Unit Self-Diagnostic Mode

Diagnostic Tool

Symptom Chart

Pinpoint Tests

2002 Lincoln LS Contents/Index

GROUP 15: Audio Systems

SECTION 415-01:
Audio Unit

SPECIFICATIONS

DESCRIPTION AND OPERATION

Audio System

DIAGNOSIS AND TESTING

Audio System

REMOVAL AND INSTALLATION

Audio Unit

Compact Disc (CD) Changer

Subwoofer Amplifier

Amplifier - Center Imaging

Auxiliary Control - Steering Wheel Switch

2002 Lincoln LS Contents/Index

GROUP 15: Audio Systems

SECTION 415-02:
Antenna

SPECIFICATIONS

DESCRIPTION AND OPERATION

Antenna

GENERAL PROCEDURES

Antenna Grid Wire Repair

REMOVAL AND INSTALLATION

Antenna

Cable

Module Isolator

2002 Lincoln LS Contents/Index
GROUP 15: Audio Systems

SECTION 415-03:
Speakers

DESCRIPTION AND OPERATION
Speakers

REMOVAL AND INSTALLATION

Speaker - Door Mounted

Subwoofer Speaker

2002 Lincoln LS Contents/Index

GROUP 17: Lighting

SECTION 417-01:
Exterior Lighting

SPECIFICATIONS

DESCRIPTION AND OPERATION

Exterior Lighting

DIAGNOSIS AND TESTING

Headlamps

Principles of Operation

Inspection and Verification

FEM Diagnostic Trouble Code (DTC) Index

Symptom Chart

Autolamps

Principles of Operation

Inspection and Verification

Symptom Chart

Stoplamps

Principles of Operation

Turn Signal and Hazard Lamps

Principles of Operation

Inspection and Verification

Symptom Chart

Pinpoint Tests

Parking, Rear and License Lamps

Principles of Operation

Inspection and Verification

Symptom Chart

Fog Lamps

Principles of Operation

Inspection and Verification

Symptom Chart

Pinpoint Test

Reversing Lamps

Principles of Operation

Inspection and Verification

Symptom Chart

Trailer Lamps

Principles of Operation

Inspection and Verification

Symptom Chart

Pinpoint Tests

GENERAL PROCEDURES

Headlamp Adjustment

Headlamp Aiming

Photometric Aiming

Screen Method Aiming

Mechanical Aiming

REMOVAL AND INSTALLATION

Bulb - Headlamp

Bulb - Fog Lamp

Lamp Assembly - Headlamp

Lamp Assembly - Fog Lamp

Lamp Assembly - Stoplamp

Lamp Assembly - Rear

Lamp Assembly - High Mounted Stoplamp

License Plate Lamp

Reversing Lamp

Lamp Switch - Headlamp

Lamp Switch - Brake Pedal Position (BPP)

Photocell and Amplifier - Light Sensor

2002 Lincoln LS Contents/Index
GROUP 17: Lighting

SECTION 417-02:
Interior Lighting

DESCRIPTION AND OPERATION
Interior Lighting

DIAGNOSIS AND TESTING

Interior Lighting

Principles of Operation

Symptom Chart

REMOVAL AND INSTALLATION

Lamp Assembly - Rear Reading

Lamp Assembly - Front Map

2002 Lincoln LS Contents/Index
GROUP 17: Lighting

SECTION 417-04:
Daytime Running Lamps

DIAGNOSIS AND TESTING
Daytime Running Lamps (DRL)
Principles of Operation

Inspection and Verification

SECTION 418-00:
Module Communications Network

SPECIFICATIONS

DESCRIPTION AND OPERATION

Communications Network

DIAGNOSIS AND TESTING

Communications Network

Principles of Operation

Inspection and Verification

System Precheck

Symptom Chart

Pinpoint Tests

GENERAL PROCEDURES

Communication Circuit Wiring Repair

SECTION 418-01:
Module Configuration

DIAGNOSIS AND TESTING
Module Configuration
Principles of Operation

Inspection and Verification

SECTION 419-01A:
Anti-Theft Perimeter

SPECIFICATIONS

DESCRIPTION AND OPERATION

Anti-Theft Perimeter

DIAGNOSIS AND TESTING

Anti-Theft Perimeter

Inspection and Verification

Symptom Chart

Pinpoint Tests

REMOVAL AND INSTALLATION

Switch Front Door Ajar

Switch Rear Door Ajar

SECTION 419-01B:
Anti-Theft PATS

SPECIFICATIONS

DESCRIPTION AND OPERATION

Anti-Theft Passive Anti-Theft System (PATS)

DIAGNOSIS AND TESTING

Anti-Theft Passive Anti-Theft System (PATS)

Inspection and Verification

Symptom Chart

Pinpoint Tests

GENERAL PROCEDURES

Security Access Procedure

Key Programming Program a Key Using Two Programmed Keys

Key Programming Erase All Key Codes and Program Two Keys

Key Programming Enable/Disable Spare Key Programming

Key Programming Additional Key With One Programmed Key

REMOVAL AND INSTALLATION

Module Passive Anti-Theft Transceiver

2002 Lincoln LS Contents/Index
GROUP 19: Electronic Feature Group

SECTION 419-02:
Remote Convenience

DESCRIPTION AND OPERATION
Universal Transmitter

DIAGNOSIS AND TESTING

Universal Transmitter

Inspection and Verification

Symptom Chart

Pinpoint Tests

GENERAL PROCEDURES

Programming

Training a Garage Door Opener Equipped With "Rolling Codes"

Erasing Channels

SECTION 419-05:
Telematics

SPECIFICATIONS

DESCRIPTION AND OPERATION

Telematics

DIAGNOSIS AND TESTING

Telematics

Principles of Operation

Inspection and Verification

Diagnostic Tool

Audio Unit Self-Diagnostic Mode

System/Carrier Concerns

Other Possible Concerns

Symptom Chart

Pinpoint Tests

REMOVAL AND INSTALLATION

Telematics Control Module

Telematics Control Switch

Global Positioning System (GPS) Antenna

Microphone

Portable Support Electronics (PSE) Module

Cellular Phone Antenna

SECTION 419-10:
Multifunction Electronic Control Modules

SPECIFICATIONS

DESCRIPTION AND OPERATION

Module Controlled Functions

DIAGNOSIS AND TESTING

Multifunction Electronic Module

REMOVAL AND INSTALLATION

Module - Driver Door (DDM)

Module - Driver Seat (DSM)

Module - Rear Electronic (REM)

Module - Front Electronic (FEM)

2002 Lincoln LS Contents/Index
GROUP 19: Electronic Feature Group

SECTION 419-11:
Electronic Compass

DESCRIPTION AND OPERATION
Electronic Compass

DIAGNOSIS AND TESTING

Electronic Compass

Inspection and Verification

Symptom Chart

Pinpoint Tests

GENERAL PROCEDURES

Compass Zone Adjustment

Compass Calibration

Vehicle Demagnetizing

2002 Lincoln LS Contents/Index

-- T --

Telematics Control Module

Telematics Control Switch

Telematics

DESC & OPER: Telematics

DIAG & TEST: Telematics

Section Table of Contents

Thermostat Housing 3.0L

Thermostat Housing 3.9L

Thermostat 3.9L

Thermostatic Expansion Valve Manifold and Tube Assembly 3.0L

Thermostatic Expansion Valve Manifold and Tube Assembly 3.9L

Thermostatic Expansion Valve 3.9L

Throttle Body

REM & INST: Fuel Charging and Controls 3.0L (4V)

REM & INST: Fuel Charging and Controls 3.9L

Throttle Position (TP) Sensor 3.0L

Throttle Position (TP) Sensor 3.9L

Tilt/Telescopic Motors

Timing Adjustment

Timing Drive Components Primary

Timing Drive Components Secondary

Timing Drive Components

Toe Link

Torque Converter Cleaning And Inspection

Torque Converter Diagnosis

Torque Converter End Play Check

Torque Converter Flushing

Torque Converter Impeller to Pump Stator Interference Check

Torque Converter Leak Check

Torque Converter One-Way Clutch Check

Torque Converter Turbine to Pump Stator Interference Check

Torque Converter

DESC & OPER: Automatic Transmission - 5R55N

DISASSEM & ASSEM OF SUBASSEM: Automatic Transmission - 5R55N

Torsion Bar Loading

Traction Control Actuator - Advance Trac

Traction Control Actuator

Trailer Lamps

Transaxle/Transmission Cooling, Section Table of Contents

Transducer - Primary

Transducer - Secondary

Transmission Connector Layouts

Transmission Control Switch

Transmission Cooling

DESC & OPER: Transaxle/Transmission Cooling

DIAG & TEST: Transaxle/Transmission Cooling

Transmission Description

Transmission Drive Cycle Test

Transmission Electronic Control System

Transmission Fluid Cooler Flow Test

Transmission Fluid Cooler Tubes

Transmission Fluid Cooler Backflushing and Cleaning

GEN PROC: Automatic Transmission - 5R55N

GEN PROC: Transaxle/Transmission Cooling

Transmission Fluid Cooler

Transmission Fluid Drain and Refill - Automated Equipment

Transmission Fluid Drain and Refill - Vehicles With Torque Converter Drain Plug

Transmission Fluid Drain and Refill - Vehicles Without Torque Converter Drain Plug

Transmission Fluid Level Check

Transmission Range (TR) Sensor Adjustment

Transmission Support Insulator

Transmission

ASSEM: Automatic Transmission - 5R55N

DISASSEM: Automatic Transmission - 5R55N

INST: Automatic Transmission - 5R55N

INST: Manual Transaxle/Transmission

REM: Automatic Transmission - 5R55N

REM: Manual Transaxle/Transmission

Trim Panel - A-Pillar Lower

Trim Panel - Front Door

Trim Panel - Package Tray

Trim Panel - Quarter

Trim Panel - Rear Door

Trim Panel - Upper B-Pillar

Trim Panel - Windshield Side Garnish Moulding

Trough Assembly

Turn Signal and Hazard Lamps

2002 Lincoln LS Contents/Index

-- U --

Underbody Misalignment Check

Uni-Body, Subframe and Mounting System, Section Table of Contents

Universal Joints

Universal Transmitter

DESC & OPER: Remote Convenience

DIAG & TEST: Remote Convenience

Upper Arm - Left Side

Upper Arm - Right Side

Upper Arm

Upper Intake Manifold

2002 Lincoln LS Contents/Index

-- V --

Valve Clearance Adjustment

Valve Clearance Check

Valve Cover LH

IN-VEH REP: Engine 3.0L (4V)

IN-VEH REP: Engine 3.9L

Valve Cover RH

IN-VEH REP: Engine 3.0L (4V)

IN-VEH REP: Engine 3.9L

Valve Seals

Valve Spring Strength

Valve Spring Lash Adjustment

Valve Spring Springs, Retainers, and Stem Seals

Valve Springs

Valve Tappet

Valve Dual Coolant Flow

Valve Guide Inner Diameter

Valve Inspection

Valve Seat Inspection

Valve Seat Runout

Valve Seat Width

Valve Spring Free Length

Valve Spring Squareness

Valve Stem Diameter

Valve Stem to Valve Guide Clearance

Vehicle Demagnetizing

Vehicle Speed Control

DESC & OPER: Vehicle Speed Control

DIAG & TEST: Vehicle Speed Control

Section Table of Contents

Vehicle Speed Sensor (VSS)

Visual Inspection

-- W --

Warning Devices
DESC & OPER: Warning Devices

DIAG & TEST: Warning Devices

Section Table of Contents

Washer Pump and Reservoir

Water Pump 3.0L

Water Pump 3.9L

Weld Nut Repair "J" Nut, Restraints Control Module (RCM) and Side Impact Sensor

Weld Nut Repair Missing Weld Nut, Restraints Control Module (RCM) and Side Impact Sensor

Weld Nut Repair Stripped Weld Nut, Restraints Control Module (RCM) and Side Impact Sensor

Wheel Alignment Angles

Wheel And Tire

Wheel Bearing and Hub

Wheel Bearing Check

Wheel Bearing Inspection Front and Rear

Wheel Hub

Wheel Knuckle

REM & INST: Front Suspension

REM & INST: Rear Suspension

Wheel Leaks

Wheel Studs

REM & INST: Front Suspension

REM & INST: Rear Suspension

Wheels And Tires

DESC & OPER: Wheels and Tires

DIAG & TEST: Wheels and Tires

Wheels and Tires, Section Table of Contents

Window Glass - Back

Window Glass - Front Door

Window Glass - Rear Door

Window Glass - Rear Quarter

Window Regulator - Front Door

Window Regulator - Rear Door

Windshield Glass

Windshield Wiper Motor

Wiper Blade and Pivot Arm Adjustment

Wipers and Washers

DESC & OPER: Wipers and Washers

DIAG & TEST: Wipers and Washers

Section Table of Contents

Wiring Repair

2002 Lincoln LS
Contents/Index

-- Y --

Yaw Rate Sensor

2002 Lincoln LS
Contents/Index

GROUP 00: Service Information

SECTION 100-01: Identification Codes

SECTION 100-02: Jacking and Lifting

SECTION 100-04: Noise, Vibration and Harshness

2002 Lincoln LS
Contents/Index

GROUP 01: Body

SECTION 501-00: Body System General Information

SECTION 501-02: Front End Body Panels

SECTION 501-03: Body Closures

SECTION 501-05: Interior Trim and Ornamentation

SECTION 501-08: Exterior Trim and Ornamentation

SECTION 501-09: Rear View Mirrors

SECTION 501-10: Seating

SECTION 501-11: Glass, Frames and Mechanisms

SECTION 501-12: Instrument Panel and Console

SECTION 501-14A: Handles, Locks, Latches and Mechanisms

SECTION 501-14B: Keyless Entry/Computer Operated Locks

SECTION 501-16: Wipers and Washers

SECTION 501-17: Roof Opening Panel

SECTION 501-19: Bumpers

SECTION 501-20A: Safety Belt System

SECTION 501-20B: Supplemental Restraint System

2002 Lincoln LS
Contents/Index

GROUP 02: Frame and Mounting

SECTION 502-00: Uni-Body, Subframe and Mounting System

2002 Lincoln LS Contents/Index

GROUP 03: Engine

SECTION 303-00: Engine System - General Information

SECTION 303-01A: Engine - 3.0L (4V)

SECTION 303-01B: Engine - 3.9L

SECTION 303-03: Engine Cooling

SECTION 303-04A: Fuel Charging and Controls - 3.0L (4V)

SECTION 303-04B: Fuel Charging and Controls - 3.9L

SECTION 303-05: Accessory Drive

SECTION 303-06: Starting System

SECTION 303-07A: Engine Ignition - 3.0L (4V)

SECTION 303-07B: Engine Ignition - 3.9L

SECTION 303-08: Engine Emission Control

SECTION 303-12: Intake Air Distribution and Filtering

SECTION 303-13: Evaporative Emissions

SECTION 303-14: Electronic Engine Controls

2002 Lincoln LS
Contents/Index

GROUP 04: Suspension

SECTION 204-00: Suspension System - General Information

SECTION 204-01: Front Suspension

SECTION 204-02: Rear Suspension

SECTION 204-04: Wheels and Tires

2002 Lincoln LS
Contents/Index

GROUP 05: Driveline

SECTION 205-00: Driveline System - General Information

SECTION 205-01: Driveshaft

SECTION 205-02: Rear Drive Axle/Differential

SECTION 205-05: Rear Drive Halfshafts

2002 Lincoln LS
Contents/Index

GROUP 06: Brake System

SECTION 206-00: Brake System - General Information

SECTION 206-03: Front Disc Brake

SECTION 206-04: Rear Disc Brake

SECTION 206-05: Parking Brake and Actuation

SECTION 206-06: Hydraulic Brake Actuation

SECTION 206-07: Power Brake Actuation

SECTION 206-09A: Anti-Lock Control

SECTION 206-09B: Anti-Lock Control - Traction Control

SECTION 206-09C: Anti-Lock Control - Traction Control and Stability Assist

2002 Lincoln LS
Contents/Index

GROUP 07: Automatic Transmission

SECTION 307-01: Automatic Transmission - 5R55N

SECTION 307-02: Transaxle/Transmission Cooling

SECTION 307-05: Automatic Transaxle/Transmission External Controls

2002 Lincoln LS
Contents/Index

GROUP 08: Manual Transmission, Clutch and Transfer Case

SECTION 308-00: Manual Transaxle/Transmission and Clutch General Information

SECTION 308-01: Clutch

SECTION 308-02: Clutch Controls

SECTION 308-03: Manual Transaxle/Transmission

2002 Lincoln LS
Contents/Index

GROUP 09: Exhaust System

SECTION 309-00: Exhaust System

2002 Lincoln LS
Contents/Index

GROUP 10: Fuel System

SECTION 310-00: Fuel System - General Information

SECTION 310-01: Fuel Tank and Lines

SECTION 310-02: Acceleration Control

SECTION 310-03: Vehicle Speed Control

2002 Lincoln LS
Contents/Index

GROUP 11: Steering System

SECTION 211-00: Steering System - General Information

SECTION 211-02: Power Steering

SECTION 211-04: Steering Column

SECTION 211-05: Steering Column Switches

2002 Lincoln LS Contents/Index

GROUP 12: Climate Control System

SECTION 412-00: Climate Control System - General Information

SECTION 412-01: Air Distribution and Filtering

SECTION 412-02: Heating and Ventilation

SECTION 412-03: Air Conditioning

SECTION 412-04: Control Components

2002 Lincoln LS Contents/Index

GROUP 13: Instrumentation and Warning Systems

SECTION 413-00: Instrument Cluster and Panel Illumination

SECTION 413-01: Instrument Cluster

SECTION 413-06: Horn

SECTION 413-08: Information and Message Center

SECTION 413-09: Warning Devices

2002 Lincoln LS
Contents/Index

GROUP 14: Battery and Charging System

SECTION 414-00: Charging System General Information

SECTION 414-01: Battery, Mounting and Cables

SECTION 414-02: Generator and Regulator

2002 Lincoln LS
Contents/Index

GROUP 15: Audio Systems

SECTION 415-00: Entertainment System - General Information

SECTION 415-01: Audio Unit

SECTION 415-02: Antenna

SECTION 415-03: Speakers

2002 Lincoln LS
Contents/Index

GROUP 17: Lighting

SECTION 417-01: Exterior Lighting

SECTION 417-02: Interior Lighting

SECTION 417-04: Daytime Running Lamps

2002 Lincoln LS
Contents/Index

GROUP 18: Electrical Distribution

SECTION 418-00: Module Communications Network

SECTION 418-01: Module Configuration

2002 Lincoln LS
Contents/Index

GROUP 19: Electronic Feature Group

SECTION 419-01A: Anti-Theft - Perimeter

SECTION 419-01B: Anti-Theft - PATS

SECTION 419-02: Remote Convenience

SECTION 419-05: Telematics

SECTION 419-10: Multifunction Electronic Control Modules

SECTION 419-11: Electronic Compass

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2002 Lincoln LS
Workshop Manual

Alphabetical Index

A B C D E F
G H I J K L
M N O P R S
T U V W Y

Table of Contents

1: General Information

00: Service Information

2: Chassis

04: Suspension

05: Driveline

06: Brake System

11: Steering System

3: Powertrain

03: Engine

07: Automatic Transmission

08: Manual Transmission, Clutch and Transfer Case

09: Exhaust System

10: Fuel System

4: Electrical

12: Climate Control System

13: Instrumentation and Warning Systems

14: Battery and Charging System

15: Audio Systems

17: Lighting

18: Electrical Distribution

19: Electronic Feature Group

5: Body and Paint

01: Body

02: Frame and Mounting